Addis Ababa University

School of Graduate Studies

WILLINGNESS TO PAY

FOR IMPROVED WATER SERVICES

IN SIERRA LEONE: EVIDENCE FROM MAKENI

BY

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Dedication

This piece of work is dedicated to my fiancée, Miss Mwilla Mbegu for her unleashing support during the course of this thesis work.

"Research is not good simply because it is mathematical or statistical, or because it makes use of ingenious machines. Research is good if it is significant, if it is fruitful, if it is consistent with established principles, or if it helps to overthrow erroneous principles."

1. HENRY SCHULTZ

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List of Abbreviations

AAU Addis Ababa University

CV Contingent Valuation

CVM Contingent Valuation Method

GOSL Government of Sierra Leone

GVWC Guma Valley Water Company

HPM Hedonic Pricing Method

NGO Non Governmental Organisation

OLS Ordinary Least squares

SALWACO Sierra Leone Water Company

TCM Travel Cost Method

WTA Willingness To Accept

WTP Willing (ness) To Pay

ABSTRACT

Many developing are experiencing rapid urbanization in human settlements, at the same time, available fresh water supplies continue to decline. Recognizing the harm to health, economic productivity, and quality of life that can result from inadequate services, international donors and governments of developing countries have mounted numerous efforts to avert this problem. So far, the strategies of these organizations have been supply oriented, totally ignoring the importance of demand in the selection of appropriate policies. Hence, it is necessary to undertake a study on the demand side, which will depicts the needs of the consumers and whether they are willing to pay for such services.The study used the Contingency Valuation Method with a checklist format and bidding game to analyse households' Willingness To Pay for improved water services in Makeni, and to determine the appropriateness of the existing government policy in relation to water supply and draw up appropriate policy implications and recommendations based on the findings.Descriptive analysis of survey findings reveals that households in Makeni are willing to pay less than the previously existing tariff. Despite this, the aggregate WTP value per month is Le14 million (approximately US$7000) and this amount is almost ten times greater than the previously realised monthly figure. The results further reveal that starting point bias affects the final willingness to pay bids of the respondents. The multivariate analysis used the Heckman selection model. The probit results indicate that responsibility for water management, water quality and income produce the largest marginal effects. The OLS results depict that willingness to pay is positively related to income, education and water quality while it is negatively related to the age of the respondent and responsibility. However, since the contingent valuation method is hypothetical, the estimated values should be regarded as approximations and that the actual behaviour of the households can only be gauged when the improved water system is reintroduced.

CHAPTER ONE

INTRODUCTION

1.1 General Background

Water is a natural resource that may be classified as renewable or depletable, depending on the source and on use. Water supplies come from surface waters and ground water. Surface water includes lakes, streams and oceans. These are renewable water sources, provided by the earth's hydrologic cycle. Ground water is water that has been accumulated over hundreds of thousands of years in underground aquifers that lie between layers of rock. Ground water is primarily a depletable water stock, although a small proportion (less than five percent) can be withdrawn each year and renewed by seepage of rainwater or snow melting into the aquifer. (Hartwick and Olewiler, 1998 pp75).

While the total supply of surface and ground water is quite large compared with current aggregate rates of use, there are many parts of the world where water is extremely scarce because of climatic conditions, geography, patterns of use and water pricing policies. This is the case for the South-western United States, parts of Africa, the Middle East, parts of Australia and Asia, and Latin America (ibid).

The economics of water has also been relatively little researched in comparison to its importance, because, perhaps, of its relative abundance. This abundance may however have applied in many of the economically most important countries but it does not certainly apply to the majority of

poor countries and there are many indications that water scarcity will become a global problem affecting an ever-growing number of countries. (Aguilar and Sterner, 1995:8).

The increasing stress on Africa's fresh water resources is due to natural and human causes. Rapid population growth, pollution from pesticides and fertilizers, and industrial effluent, all contribute to Africa's water stress. Another cause of stress is environmental degradation. Forests, which serve as important catchments areas, are being cleared for fuel wood, lumber and agriculture. As water becomes scarcer and its quality continues to deteriorate, policy makers have been compelled to explore new approaches to improve the management of water resources. Water pricing reforms are among various measures designed to encourage the efficient use of water resources.

A convenient supply of safe water and the sanitary disposal of human wastes are essential ingredients of a healthy and productive life. Water that is not safe for human consumption can spread disease; water that is not conveniently located results in the loss of productive time and energy of the water carrier. It is invariably the poor who suffer the most from the absence of safe water because they lack not only the means to provide for such facilities but also the information to minimize the ill effects that may arise. As a result, the debilitating effects of endemic diseases lower the productive potential of the very people who can least afford it. Water is one of the most essential elements of life. Water is life- without water there can be no future. We humans depend not only on an intake of water to replace the continual loss of body fluids, but also the food we depend on needs water.

In a special session on 10 November 1980, the UN General Assembly declared the 1980s to be the International Drinking Water Supply and Sanitation Decade. One of the objectives of the

Decade was to provide an adequate supply of safe water for all by 1990. But this was far from being realized as millions of people around the globe continue to live without access to safe water for domestic purposes. For instance, over 300 million people in Africa still do not have reasonable access to safe drinking water and almost half the people of the African continent suffer from water related diseases[1].

1.2 Statement of the Problem

Sierra Leone is endowed with massive water resources, many running streams and rivers. The long-term average annual rainfall approaches 6000mm at the higher altitudes during the rainy season. The Country is classified by the UN-HABITAT to be among the water abundant countries in Africa with an annual per capita availability of renewable fresh water of 28,545m^3/person/year in 1990. Despite this, access to safe drinking water is out of reach for the majority of Sierra Leoneans. At the same time, it is one of our most essential and valuable inputs and also the one that is perhaps most commonly overlooked and taken for granted. Clean water is a 'merit good' that confers relatively large social benefits on society, which far outweigh the cost of its provision. It is also a non-substitutable resource. A 'merit good' is a good whose consumption is deemed to be intrinsically desirable. In the case of such goods, it is argued that consumer sovereignty does not hold and that if consumers are unwilling to purchase 'adequate' quantities of such goods, they should be encouraged to do so. Clean water adds to the quality of life through cost saving in medical and other bills.

1. Statement of African Ministerial Conference on Water (AMCOW), at the World Summit on Sustainable Development.

Due to the free availability of water in the streams and rivers of Sierra Leone through falling precipitation, the resource has been taken for granted and as a free good. The economic effects of drinking unsafe water include changes in expenditures and well being in terms of medical costs, lost earnings, lost production in the home, lost leisure time, and mitigating expenditures.

Potable water supply networks in Sierra Leone are almost entirely based on the use of surface sources, little is known about the extent of underground resource outside Freetown, where there is no ground water resource (Public Administration Services, 1995). Water has always been considered by people as a free good. In many cases, lack of knowledge about the protection of the water cycle, misuse and lack of legal and management structures are the main cause of scarcity or stress of water. Again, there has been almost no investment in the water sector by the Sierra Leone Government due to economic problems, and pressure from the World Bank and IMF to reduce public expenditures.

It is almost customary to treat piped water as a public service, which the government should provide for free, when it is in fact anything but free. Individuals expect that it is their right to take and waste as much water as they want (Baumol and Oates, 1979). The paradox here is that water falls between two extremes, i.e., a ‘pure public good’ and a ‘pure private good. Water is a pure public good when left in a scenic river or when it is supplied through a public stand pump. Industrial water is a private good, but residential water can supply external health benefits and is therefore neither a pure public good nor a private good.

At most 10 percent of the rural population and 60 percent of the urban population in Sierra Leone have access to safe drinking water. Unsafe water supplies are a serious environmental problem because of the effects on human welfare and economic growth. In Makeni (the study area), communities rely at the moment primarily on unprotected shallow wells for water supply as the Sierra Leone Water Company (SALWACO) has ceased operations due to the high costs of meeting the targeted water supply. Since all houses depend on their water wells for the supply of drinking water, it is very common to find a toilet and water well located at a very close distance within the same compound, thus reducing the potential benefit of safe water supply through the transmission of pathogens. It is not uncommon to find reported cases of diarrhoea and other water borne diseases in Makeni especially during the rainy season.

Improving the quality of water supply is a priority for both rural and urban development, but the strategy of donor organizations and governments are not demand oriented; as they are supply driven i.e. improve water supply and management strategies by providing technical expertise and training. Thus the fundamental importance of the value the consumers place on the environmental good has been ignored. Failing to get a price for improved water supply use, there would be no control system in the economy to check overuse of the resource and distortions will result in the water sector. Since water lies between a pure public good and private good, the market mechanism cannot provide appropriate signals in the form of prices. The government must therefore intervene in some form. Thus, if consumers are willing to pay for improved water services, then the welfare gains may be considerable; otherwise, it might lead to a waste of public resources to improve the service.

In the absence of access to a public or private water supply system, individuals can either acquire water as a basic existence good through purchase from the informal sector (more common in

urban areas), whilst more rural locations have the alternative option of accessing groundwater. Both these options are an indication of the state's lack of capacity to develop water infrastructure and provide its population with water on an equitable basis.

1.3 Objectives

Effective policy making and planning must take into account what consumers want and are prepared to pay for the provision and improvement of an environmental good and how to utilize the resource sustainably i.e., the implementation of allocation decision should focus on the demand side instead of the traditional approach which focuses on the supply side. Thus, this study intends to look at the value of safe water services in Makeni through the determination of appropriate monetary values for the services. The ultimate desired objective of the study is to investigate the determinants of household's willingness to pay (WTP) for improved water services in Makeni using the Contingency Valuation Method (CVM). On the basis of the above therefore, the specific objectives are:

(a) To estimate and analyse household's WTP for improved water services.

(b) To estimate the factors that contributes to households' decision making as to whether to connect to the improved system or not.

(c) To test the plausibility of the CVM in estimating the WTP for water services.

(d) To determine the appropriateness of the existing government policy in relation to water supply and draw up appropriate policy implications and recommendations based on the findings.

(e) To test for starting point bias.

1.4Significance of the study

This study aims to provide the required information on the ability and willingness of the people of Makeni not only to pay for water services but also to sustain their supplies, which include paying for maintenance and operation, extension and replacement costs. While there has been few attempts on the subject in Sierra Leone, a good number of such attempts were only limited to Freetown, thus, this study will be one of the few to be conducted outside the city and will therefore serve as an additional contribution countrywide.

The most significant aspect of the study is that, Makeni had a constant piped water supply up to the mid 80s, by the late 80s, SALWACO resorted to rationing and currently, there is no such supply in the town. Hence, the problem is not only the quality of water but also availability. Therefore the results of the investigation are expected to be of interest to the Authorities and Non Governmental Organizations operating in the area. Indeed, a review by the World Health Organization of the International Decade of Drinking Water and Sanitation stated that financial constraints were the single most serious obstacle to the progress of the Decade's goals. Clearly, WTP has a role in assessing acceptable water charges to users upon which water policy can be developed with the confidence of achieving cost recovery.

According to Singh *et al* (1993), any attempt to estimate behaviour and thus benefits in a particular community on the basis of results of studies on other communities and settings can lead to serious, misleading and erroneous conclusions. This is true even when natural conditions

between communities and the service to be offered are apparently quite similar. In view of this fact, there is still a challenge to prove the relevance of CVM in Makeni and prescribe appropriate policies based on the findings.

1.5 Hypotheses of the study

(a) WTP depends on the problems of existing drinking water services.

(b) WTP is a function of the income of the household.

(c) The educational level is a crucial factor in explaining WTP of the respondent. There is a significant positive relationship between educational level and WTP of the respondent.

(d) The sex of the respondent is significant in explaining the WTP of the respondent.

(e) There is a significant inverse relationship between WTP for water services and the behaviour of the respondent in terms of expecting the government to provide free water services.

(f) There is no significant difference between the determinants of WTP and the determinants of the ability to connect to the improved water system

(g) The suggestion of an initial starting point in a bidding game can significantly influence the final bid.

1.6 Organization of the rest of the study

The rest of the thesis will be presented as follows: relevant theoretical and empirical literature will be reviewed in chapter 2; the scope and methodology will be presented in chapter 3; an

overview of the study area, empirical findings and interpretation of results will be outlined in chapter 4. Finally, conclusion and policy recommendations will be presented in chapter 5.

CHAPTER TWO

THEORETICAL AND LITERATURE REVIEW

2.1 Theoretical Review

Environmental goods lack price tags and are mostly characterized as public goods with substantial doubt surrounding their true value. Throughout the development of economics, there is no consistent definition of "value". Value is at times, used as synonymous to the price of a resource. Earlier philosophers tried to make a distinction between market price of an environmental resource and its value. The term value was then thought to imply importance or essentiality.

Adam Smith (1722-1790) and David Ricardo (1772-1923) tried to make a distinction between the value and price of goods. According to Adam Smith, the value of a resource is its "value in use" and that price represents its "value in exchange". The distinction between these concepts led to the well-known Water Diamond paradox. Water, which is a basic necessity of life with a greater "value in use", has little "value in exchange", while diamonds which have little practical use relative to water, command a greater "value in exchange".

The Marginalists (1850- 1880) redefined the concept of value in use from the idea of total usefulness to marginal usefulness. According to this school of thought, it is not the overall usefulness of a resource that helps to determine its exchange value but usefulness of the last unit consumed. The centrepiece here is that, even though water is very useful, its abundance implied that, consuming one more unit has a relatively lower value to people.

Alfred Marshall (1890) tried to resolve the paradox, he showed that demand and supply simultaneously operate to determine the price that reflects both the marginal valuation that buyers place on a resource and the marginal cost of producing the resource. In the case of water, it is relatively cheap because both the marginal value and marginal cost of production are low. It must be noted that this statement holds only in areas with relatively abundant water supply. On the other hand, diamonds have both high marginal value and marginal cost of production, thus; they are relatively expensive.

2.2 Valuation Methods

Theoretically, the total value/ benefits of some environmental improvement such as improved water can be classified into two categories.

Total Economic Value = Use Value +Non-use Value.

Use value comprises direct and indirect value, which is simply "value in use", option value, quasi-option value and bequest value. For example, people use a clean river for swimming, boating, drinking or bathing. An environmental resource is said to have a quasi-option value if the future benefits it might yield are uncertain and depletion of the resource is effectively irreversible. In brief, one would be willing to pay to preserve the resource simply because it might prove valuable at some time in the future. Option value was seen to arise when an

individual was uncertain as to whether he would demand a good in some future period and was faced with uncertainty about the availability of that good. Non-use values also comprise of bequest value and existence value. Consequently, even if a certain environmental good has neither use value nor option value, people can still protect it because they believe that all creatures have the right to exist, hence, the existence value.

Economists have in recent decades developed various valuation techniques to estimate the value that consumers place on public goods. These methods can be distinguished on the basis of the process by which they retrieve people's preferences.

(a) Non-preference methods, which include shadow cost method (opportunity costs) and implicit valuation.

(b) Revealed preference methods, which include Travel Cost Method (TCM), Hedonic Pricing Method (HPM), Averting Behaviour Method and Production Factor Method.

(c) Expressed Preference Method (direct approach), example, survey method using Contingent Valuation Method (CVM).

2.2.1. Non-Preference Methods

This method suggests that water works may lead to a drop in the ground water level as well as altering the ecosystem and its productive potential. Under such circumstances, consumer price must be set to reflect not only the production costs but also the costs in terms of the environmental impacts of resource extraction. The price must equal the marginal opportunity cost, which is also equal to the long run marginal cost, plus the external cost of water extraction and forgone benefits of future users. The price must be set in such a way that poor people can

also afford the service and at the same time sustainability is maintained. But it must be noted that this approach is beyond the scope of this study due to the fact that long run marginal cost and marginal opportunity cost requires extensive information on externalities and the forgone benefits.

2.2.2. Preference Methods

The Revealed and Expressed Preference methods are explained in this sub section. In circumstances where markets for environmental goods are absent, not fully developed, or there are no alternative markets, it becomes impossible to value the impact on the environment of a particular project by using the market. Given this condition, it is possible to estimate implicit values for such goods or services by means of the price paid for another good that is marketed. Three valuation techniques that are commonly used are the HPM, TCM and CVM.

2.2.2.1. Hedonic Pricing Method

This method imputes a price for an environmental good by examining the effects, which its presence has on a relevant market-priced good. The objective of HPM studies is to define the inverse demand function relating the quality of the environmental good to the individual's marginal WTP for that good. Hedonic pricing of unmarketed environmental service is based on the following principle: that the environmental resource we wish to value has no defined market, where individuals can reveal their preferences or WTP for the resource such as improved water or air quality.

In general, goods and services consist of a bundle of attributes that make up the good like water quality in the case of a house. HPM can be used to estimate the value an individual places on the

improvement of water services. Whilst there is no well-defined market for drinking water, it is an attribute, which may influence residential property prices. Evidence from revealed preference suggests that, ceteris paribus, a positive relationship exists between the prices that people are willing to pay for housing and the quality of water services (Freeman, 1979; Bah, 1996). Thus, it is clear that the HPM involves amongst others the estimation of an equation of the following form:

$P_i = f(S_{1i} \ldots S_{ki}, N_{1i} \ldots N_{mi}, Z_{1i} \ldots Z_{ni})$ ---------- (1)

Where P_i is the price of the property,

Si represents the structural characteristics, example, house size,

Ni is the neighbourhood characteristics, example, local crime rates, and

Zi represents the environmental characteristics, example, clean water.

In this respect, the price of a heterogeneous good like a house can be decomposed into the price of the attributes that make up the good such as air and water quality. However, house pricing in Makeni is not based on the availability of water quality because all houses face almost the same water conditions, hence, this method is not applicable to the present study.

2.2.2.2. Travel Cost Method

The TCM seeks to place a value on non-market environmental good by using consumption behaviour in related markets. Specifically, the costs of consuming the services of the environmental asset are used as a proxy for price. These consumption costs will include travel costs, entry fees, on-site expenditures and outlay on capital equipments necessary for

consumption. Hence, TCM depends on information about the amount of money and time people spend getting to a site in order to infer a value for that site. TCM is predominantly used in outdoor recreation modelling, with fishing, hunting, boating and forest visits are among the most popular applications. It can also be used to estimate the value of unpriced commodities such as fuel wood and water.

Although the TCM is conceptually straightforward and has primary advantages of measuring benefits based on actual behaviour, it is restricted to use values of the resource ignoring non-use values. Moreover, conducting site survey, collecting and processing the necessary data can be extremely expensive and time consuming. As a result of these difficulties, it is hard to conceive the validity of the TCM as a technique for the valuation of the demand for domestic water services as in this study. Above all, a problem of zoning will arise as almost all houses in the study area own water wells.

2.2.2.3. Contingent Valuation Methods

While the indirect market techniques described above can be used to value many of the benefits associated with environmental resource improvement, there are specific cases in which they cannot be used. For instance, they may not value non-use values because of their dependence on data from situations where consumers make actual market choices. The value of a non-marketed amenity is inferred from market data for another good with a known or estimated linkage and which requires a number of assumptions. Freeman (1979) described these methods as detective work because they price together the sacrifices that people leave behind as they respond to other economic goals. These methods measure the expected consumer surplus rather than the optional price and hence give lower values because they measure only use values of environmental

resources. This suggests that direct questioning may play a better role in valuing the benefits of water service improvement.

The CVM[2] invokes a framework of a hypothetical or contingent market, through which it seeks to elicit valuation directly from individuals. The CVM requires that individuals express their preferences for some environmental resources, or change in resource status by answering questions about hypothetical choices. The CVM is based on classical economic theory using either the Hicksian techniques, i.e., compensated variation (WTP for improved environmental resource) or equivalent variation technique (willingness to accept compensation for environmental deterioration).

Obtaining responses to a CVM can be done in various ways. Interview can either be on site (face to face; users only), house to house (face to face; users and non users) or by mail or telephone (remote; users and non users). During interviews, the respondent is faced with a questionnaire, which consists of three parts:

(a) A detailed description of the good(s) being valued and hypothetical circumstances under which the good is to be provided to the respondent. The questionnaire also includes the range of available substitutes and the method of payment. In order to be able to track a demand curve for the good, respondents are usually asked to value several levels of provision of the same good.

(b) Questions, which elicit, the respondent's WTP that are then modelled to facilitate the valuation process without biasing the respondent's WTP amounts.

2. This technique is termed "Contingent" because the good or service is not, in fact, necessarily going to be provided by the enumerator or researcher, the provision of the good or service is hypothetical.

(c) A series of questions relating to the respondent's socio-economic and demographic characteristics.

This information is used in regression equations to estimate a valuation function for the good. Successful estimates using variables, which theory identifies as predictive of people's WTP, serves as partial evidence for reliability and validity of the method.

According to Titenberg (1998) as cited in Bah's work, a major concern with the use of CVM is the potential for survey respondents to give biased answers. The major types of biases are:

***(a) Strategic Bias*:** this occurs when a respondent does not reveal his/her true preference of the good or service, i.e., he behaves strategically with the hope to "free ride".

(b) Information Bias: this can arise either as a result of providing too little information about the choice offered or from misleading statements by the interviewer.

(c) Compliance Bias: this happens when respondents in a particular cultural context feel it inappropriate to answer some kind of questions in specific ways or may attempt to give answers that they think will please the enumerator. This form of bias can result in substantial differences between reported and true WTP values.

(d) Hypothetical Bias: the potential error induced by confronting the individual with an imaginary situation, i.e., people would not behave the same way in actual market.

(e) Starting Point Bias: this occurs when the respondent's WTP amount is influenced by a value introduced by the scenario. The bidding game and the take-it-or-leave it elicitation techniques pose the most obvious threat of this kind since they directly confront the respondent with a proposed amount that the respondent is asked to accept or reject. The choice of a low (high) starting point leads to a low (high) mean WTP (Bateman and Turner, 1993). While the use of starting points may reduce non response and variance in open ended questionnaire, commentators argued that the statistically observable bias this induces indicates that such "bidding hints" lead respondents to take cognitive short-cuts to arrive at a decision rather than thinking seriously about their true WTP (Mitchell and Carson, 1989).

(f) Sampling (interview and respondent) Bias: this occurs when the very character of the interview or interviewer may influence responses. For example, if the interviewer in some way portrays the environmental good as morally desirable, or if the interviewer is highly educated (or attractive) then the respondent may feel inhibited about expressing a low WTP bid.

Another major problem is to decide which appropriate measure of welfare to use i.e., whether the compensating variation (WTP) or equivalent variation (WTA). Again, compensated variation can sometimes be described as maximum WTP only for a price decrease and equivalent variation is WTA for a price decrease and for a proposed price increase equivalent variation becomes WTP. Theoretically, they should provide estimates differing only in the effect on income caused by whether payment is made or received, and by the idea that WTP is constrained by income. Empirically, they yield different estimates, as estimates from WTA are often much larger than those from WTP.

However, despite the above-mentioned biases, the CVM generally has many advantages. According to Hoevenagel (1994), the CVM has the following strong advantages over the other methods,

(a) The applicability of this method is larger compared with other valuation methods in terms of completeness.

(b) It is able to measure a wide range of goods, including those not yet supplied in a manner consistent with economic theory.

(c) The method can measure non-use values.

(d) CVM has been judged to be superior due to its potential validity and ease with which the method can be implemented.

However, according to Pearce and Markandya (1990), the choice of the method will be determined by the choice decision in question. If the project in question has adverse effects on the residents in the area, WTA is an appropriate measure because the respondents will need to be compensated for their loss in welfare. On the other hand, if the project is socially beneficial and the residents were campaigning to obtain it, as the case of improved water services in the study area, then the maximum amount each resident would pay to express his/her need for the project would be appropriately described by WTP.

CVM is a widely applicable and applied monetary valuation method despite its limitations. It has potential application to a wider range of environmental goods than any other valuation method. It has strong theoretical basis with unique advantage, i.e., it estimates income compensating welfare measures. When surveys are properly planned and executed, most of the CVM problems can be

eliminated, thus offering the best hope for estimating environmental benefits (Whittington et al, 1993).

2.3. Empirical Literature Review

Valuation techniques have been extensively used in the recent past to value water quality improvements, the benefits of reduced air pollution and the option or existence values of wildlife area or ecologically important species. Until the 80s, the application of valuation techniques were limited in Developing Countries, nonetheless, the few available studies suggest they can successfully be applied in these countries as well (Whittington *et al.*1990 a, b, 1991; Briscoe *et al*. 1990; Boadu, 1992; Aguilar and Sterner, 1995; Alemu Mekonnen, 1997). With the rising awareness of the cost of environmental degradation in Developing Countries, together with pressures from donor organizations about the inclusion of environmental impact assessment in project designs, valuation techniques are now being used extensively to evaluate the benefits of improved water, tourism and forestry projects.

The empirical review focused first on case studies that have been carried out on water resource and later look at those studies that have been done on other resources.

2.3.1. WTP Studies: Improved Water Services

Three sets of characteristics jointly influence a household's influence for an improved water supply.

(a) The socioeconomic and demographic characteristics of the household, including education of family members; occupation; size and composition of family; and measures of income and assets.

(b) The characteristics of the existing or traditional source of water supply versus those of the improved water supply, including the cost (both financial and time required to collect water), the quality and the reliability of the supply.

(c) Household's attitudes towards government policy in the water supply sector and their sense of entitlement to government service.

Davies first used the unrefined form of the CVM in 1963 to estimate the benefits of a recreation site in Maine, USA. Since then, the CVM has been extensively used to measure the benefits from environmental improvement, ranging from improvement in water quality, reduction of pollution, to the reduction of acid rain and global warming.

The World Bank water demand research team (1987- 1991) investigated the determinants of household demand for improved water sources in Latin America (Brazil and Haiti), Africa (Anambra State in Nigeria and Zimbabwe) and South Asia (Pakistan and India). In three of the five studies, various sites in several regions of the country were investigated. Sites in Brazil included a relatively well off, water abundant area in the Southeastern State of Parona and a poor dry area in the Northeastern State of Cenra. In Pakistan, three areas in Punjab were selected. One had easy accessibility to high quality ground water; another had easy accessibility but the water is brackish, the third was in an arid zone were ground water was relatively deep and inaccessible. In India (Kerala), one area had abundant good quality ground water, the other had abundant but saline ground water and the other area suffered from water stress.

The researchers used both the revealed and expressed preference methods to show how households made their choice about water resources. The indirect method (revealed preference) used discrete choice econometric technique to derive households' decisions and estimate welfare

change for the actual choices that households made. The direct method involve asking people who did not have an improved water source whether they would use a new source if it were provided under specific conditions, and how much they would be willing to pay for access to different kinds of water systems, such as public taps or private water connections.

The findings indicate the following:

(a) The income factor was not significant although it had the expected sign. The implication is that WTP for improved water services does not solely depend on income,

(b) Better-educated households are more willing to pay for improved water supplies,

(c) The gender factor was significant in explaining households' WTP for improved water services, but the direction of that influence depends on the specific cultural context,

(d) The effects of occupation, family size and composition of a household on WTP was mixed,

(e) Households will pay more for an improved water supply when cost in terms of time and money of obtaining water from existing sources are higher than when such costs are low, and

(f)That household is willing to pay more if the water from an improved source is reliable.

The researchers concluded that the household response to a new improved water system is not due to anyone set of factors, but to their joint effects. It is this jointness that is modeled in the multivariate analysis.

Navrud (1988) used the CVM to estimate the social benefits of increased fresh water fish population based on random samples drawn from a Norwegian population, each consisting of

1000 individuals over 15 years of age. A multiple regression was estimated and most of the variables were significant at one percent and five percent levels. Some of these variables were household income, socioeconomic variables, payment instrument and fresh water angling activity. It was also found that young people have a higher WTP than those above 60 years of age. The income variable was also very significant in explaining the individual's WTP.

Whittington *et al.* (1990), employed the CVM to estimate WTP for water services in Laurent, Southern Haiti. The results of the CVM indicated that WTP for improved water services is positive for household wealth, educational level, distance from source, and quality of water and female respondents.

Whittington *et al.* (1991), implemented two approaches to estimate WTP for domestic water supplies in Onitsha, Nigeria. They carried out a survey on purchases to define the private distribution system and revealed demand for potable water. They also estimated the households' water demand behavior using a CVM survey on 235 households. The data collected from the CVM study seemed consistent with the data from the water vending surveys and the results appeared sufficiently accurate to be used for decision making of increasing the Water Authority's revenue.

Whittington *et al*. (1992), describe an application of the CVM conducted in Anambra State, Nigeria, to determine rural households' WTP for two different types of drinking water services: public taps and private house connections. The findings were, respondents who were allowed time to evaluate the proposed water system bid significantly less than those who did not have that time. This was true regardless of the type of water system (public tap or private connection). Furthermore, the multivariate analyses of WTP bids provide indirect support for concluding that

the differences were not the result of strategic behavior. Thus the study concluded that estimates based on bids from respondents who had time to think are probably better measures of the value of improved water services.

Boadu, (1992), used an iterative bidding technique to examine the relationship between selected socioeconomic household characteristics and their WTP for water. Using data collected from selected villages in Ghana, a multiple regression was estimated by OLS for each village. The results indicated that income is the key factor influencing WTP for water. Household history of water related illness and the WTP were also found to be positive. The other socioeconomic factors effect did not follow any consistent pattern and broad generalizations were not possible.

Jordan and Elnagheed, (1992), employed the CVM to estimate people's WTP for improvement in drinking water in Georgia, USA. The target was to determine the influence of different socioeconomic and demographic factors on WTP. They regress two equations and the estimation procedures employed were the weighted OLS and the Maximum Likelihood. The results were compatible to other empirical findings, for instance, WTP was found to increase with income. Income elasticity of WTP was about 0.1. Women and younger respondents were found to be more willing to pay than their counterparts. WTP was also found to increase with the level of education, thus confirming the importance of education in creating and raising people's awareness about environmental problems. The results also indicted that, on average, a private well owner was willing to pay more than an individual served by a public water system.

Whittington *et al*. (1993), conducted a Contingency Valuation Survey in Kumasi, Ghana, to estimate household's WTP for two types of improved sanitation services: improved ventilated pit latrines and water closets connected to a sewer system. The multivariate analyses indicated that

the principal determinants of households' WTP for improved sanitation services are household income, whether the respondent's household is a landlord or tenant, the household's current expenditure on sanitation, and the respondent's level of satisfaction with the household's existing sanitation system. Neither the educational level of household members nor social or cultural variables had much effect on household's WTP.

The experimental design incorporated numerous tests to check the internal consistency and reliability of the household's WTP responses, including a test for starting point bias, a " time-to-think" effect, and the effect of observers listening to the interview. These tests revealed little reason for serious concern about the reliability or validity of the WTP responses.

Carson and Mitchell, (1993), conducted a study using the CVM to determine the national benefits of water pollution control in America. By using data obtained from a national contingent valuation survey, they estimated the aggregate benefits of meeting the goal of Clean Water Act. The policy recommendation based on the study results was that the costs and benefits were roughly equal such that many of the policy actions that were attempting to ensure all water bodies at least a swimmable quality level could fail to earn positive benefits. Also, the CVM estimate from this study was close to Gramlich's (1977) CV study on Boston's residents WTP for water quality improvement in Charles River.

Singh e*t al*. (1993), used the CVM to evaluate the WTP for an improvement in the quality of water service in several rural settings in India. Respondents were allowed to consider hypothetical changes in water supply characteristics and to respond to questions about the effect on costs of connection, monthly tariff, and improved quality of service. The results revealed that the local Water Authority can lead the way to a better water service by making some critical

policy changes; encouraging private water connections by incorporating the price of connection into the monthly tariff and using the resulting increased revenues to invest in and maintain a higher quality of water service.

Aguilar and Sterner, (1995), investigated people's WTP for communal water services in three different study areas; Limon and Guanacaste (Costa Rica) and Muang Xaithani (Laos). In Limon, a survey was conducted in five villages to investigate the influence that different socioeconomic variables have on water and WTP for improved water services. Data was collected on age, head of household, educational level, quality of existing sources, water quality, information on health and others (length of time respondents have been living in their homes as well as variables measuring whose responsibility they thought water management should rest upon).

The results were consistent with their a priori expectations, although most of the variables were not significant at conventional levels. The findings indicated that, women were on the average, willing to pay more than men and younger people more than the older. The age factor is, however, not the same for men as for women. In Guanacaste, 94 out of 118 respondents were interviewed. Data was collected in all variables as in Limon, and the equation was estimated. The results were some how similar to the results obtained in Limon especially with the case of WTP. Income and age had positive effects on WTP as expected. Family size variable was found to have a negative relationship with WTP by the household. The results also indicated that, on average, the inhabitants were WTP over 40 percent, over 80 percent and over 71 percent, more than the current fees in order to receive improved services in Limon, Guanacaste and Muang Xaithani respectively.

Whittington *et al*. (1996) employed the CVM to investigate the benefits of surface water quality improvements in Davao city, Philippines. The article examined the question of the magnitude of household demand for environmental quality improvement in the context of a specific proposal; the clean up of the river and sea near Davao city. A total of 581 in-person interviews were conducted in which referendum kinds of questions were asked about a citywide plan for an improvement in water quality. Statistical methods were used to examine how different randomly assigned monthly fees influenced respondents' answers to the referendum questions. They observed that, the support for the water quality improvement falls drastically as the monthly fee increases.

Multivariate techniques were also used to estimate the mean WTP of different types of households. The results depicted that; households' WTP for water quality improvement was low, both in absolute terms and as a percentage of income.

Bah, (1997), used both the CVM and HPM to estimate the WTP for improved water services in Freetown, Sierra Leone. The regression results from the CVM study showed that, gender, educational level, income, number of years in residence, expenditure on water and respondent attitudes towards water management have significant influence on WTP for an improved water service. The HPM results indicated that the size of the household and the expenditure on water are significant in determining the rental value of a house in Freetown.

Fisseha (1997), assessed, consumers' WTP for piped water supply in Meki town, Ethiopia using the CVM. The results showed that the WTP almost doubled the current average price. The results also indicated that household's WTP for improved water service is affected by income and the

time spent to collect water from the traditional sources. But factors such as educational level, and occupation proved to be insignificant.

Dunfa (1998), used data collected from eight peasant associations and 228 farm households in the Ada'a-Liben district of Ethiopia to analyze factors that determine rural household's WTP for improved rural water provision. The results of the study depicted that income, distance from current water source; quality of water used and the availability of credit were the major determinants of WTP for safe water.

Hanley and Wasike, (1998), undertook a contingent valuation study of the value of piped water connection, under varying initial charge payment profiles to Webuye residents in Kenya. The empirical findings were that, the importance of pricing influences, particularly the initial connection charges profiles, on household decisions to connect to pipe water system.

Genanew, (1999), employed CVM to assess the determinants of households WTP for improved water services in Harrar town, Ethiopia. The study showed that WTP vary significantly according to the household level of income, educational level, and sex of the household head, starting point of the bidding game, main source of water for the household and the perceived quality of the existing water supply. The study also revealed that the mean WTP for private piped improved water connection is more than 15 times the existing authority's tariff rate. The implication is that the tariff for improved water supply can be increased substantially without constraining supply before a significant number of households would choose not to connect to an improved water system.

2.3.2. WTP Studies: Other Resources

Brookshire *et al.* (1982) used the CVM as one of the two techniques to estimate household WTP for an improvement in the quality of air in the USA. Based on data collected from 290 households, the results seemed to suggests that people are willing to pay for improved air quality, implying that the survey method is valid in measuring the value of non-marketed good.

Campbell *et al.* (1994), used an indirect CVM to determine the value of trees to smallholder farmers in three areas of Zimbabwe. The results indicated that the value of tree resources could be equivalent to between 12 and 160 percent of the annual household incomes derived from off farm employment and agricultural production. Moreover, the value of farmers obtained in the survey reflect the relative scarcity of tree resources with value of true resources being higher in areas with low tree cover than in areas with high tree cover. The added benefit from moving from a low tree cover to a high tree cover situation, in terms of improved access to resources appear to be about Z$228 for materials, Z$173 for fuel, Z$122 for crop inputs, Z$110 for ecological services and Z$91 for animal feed.

Belhaj, (1996), adopted the CVM using the iterative bidding and dichotomous approach to value the WTP for reduced air pollution in Rabat and Sale' cities in Morocco. The study established that WTP to reduce air pollution was positive with a mean WTP of 67.25 dirhams, the then equivalent of US$8.00 for the iterative choice and 63 dirhams for dichotomous choice. However, according to the author, the estimated values should be regarded as approximations because they are not only contingent upon the hypothetical market scenario presented to the respondents, but also upon the statistical analysis as well.

Kamara, (1996), employed the CVM to estimate and analyze communal livestock farmers valuation of their rangelands in the Southeast district of Botswana. A multiple regression

equation was estimated to see the influence of the various socioeconomic variables on the farmers' WTP. The results showed that the level of education of the farmer is the most significant variable influencing WTP.

Alemu, (1997), applied CVM to community forestry in Ethiopia. The results proved that, income, household size, distance of homestead to plantation, number of trees owned and sex of household head are important variables that explain WTP for community woodlots. The results of the study suggest that community afforestation projects should consider household and site specific factors as determinants of success.

Huda, (2001), used CVM to attempt a Multi-Nation valuation study that will quantify the respondents WTP for different environmental goods (reduction of global warming, reduction in air pollution, clean water and waste management), and their payment methods in South Africa. The OLS estimation method was used, and most of the coefficients were positive but statistically insignificant. The income elasticity in all of the cases was significantly less than one. It was thus surprising why the explanatory variables especially education, age, sex, failed to have statistically significant relationships with WTP.

Based on the various studies that have been carried out, the CVM proved to be a powerful tool for measuring the economic benefits of the provision of non-marketed goods, example, improved water services and air pollution. The available literature reveals that the decision of the potential users of piped water connected to the system depends on a combination of factors such as socioeconomic, demographic, quality and reliability of the system. However, Singh *et al* (1993) cautioned that when doing water valuation studies in Developing Countries, one must be very careful in applying models from Developed Countries because of differences in the nature of the

areas, cultural behavior and management styles. Water management in Advanced Countries is relatively simple as all potential users are connected to the system such that one can easily project future use and revenues for a given tariff. In a developing country like Sierra Leone, the case is quite different because primarily unprotected shallow wells, springs, ponds, streams and rivers serve the majority of the communities outside Freetown. This makes it difficult to have a clear price for water use in rural areas which in turn influences the control system in checking an over consumption and/ or misuse of this resource.

There are obvious dangers inherent in designing water supply systems without reasonable information on what services people want and for what they are willing to pay. This study will therefore use the CVM to elicit the value a typical household in Makeni places on an improved water service; based on materials from the literature that are consistent with the conditions of a developing country like Sierra Leone.

CHAPTER THREE

METHODOLOGY AND SCOPE OF THE STUDY

3.1. Scope of the Study

Due to limited time and financial constraints, the study was limited only to improved water provision in Makeni Town. Samples were drawn from the three wards[3] of the town to ensure that the general characteristics of the households in the town are reflected in the study. It must be noted that the delineation of the Town into wards is purely for administrative reasons and not on the basis of special characteristics.

3.2. Nature and Sources of Data

The study uses a cross-sectional data set obtained by administering a CV survey questionnaire to solicit respondents' stated WTP for improved water services in Makeni using the CVM with a checklist[4] format.

Three categories of variables i.e., water use problems and practices, WTP and household characteristics were obtained from the survey. In addition to the checklist format, the study also

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3.These are the divisions of the Town for representative, electoral, or administrative purposes.

4.This is a method that is similar to the payment card where the respondents are provided with a large array of potential WTP amounts ranging from zero to some large amount from which they can indicate their choice.

employed the iterative bidding elicitation technique[5] with an open-ended format on half of the sample. The primary purpose of incorporating the split-sample experiment into the research design was to test whether respondents' WTP would be influenced by the magnitude of the first price that they received and the sequence of the follow-up questions. The two bidding games and the checklist format were randomly assigned to respondents in the study.

According to Dale Whittington, there are two different perspectives on such a "starting point" test. One is that the different starting points convey information about the cost of the good or service provided. From this perspective, different starting points should induce different answers from respondents. In other words, if the split-sample test elicited different answers, one would conclude that respondents were in fact taking the CV scenario seriously. The second perspective is that a respondent holds a precise WTP amount in his mind that he is trying to accurately communicate to the interviewer. If respondents who received different starting points provided essentially the same WTP answers, one would have greater confidence that they were revealing their "true" WTP.

5.This is the oldest and most widely used elicitation method in contingent valuation surveys. It is based on continuous responses. The interviewer proposes an initial starting bid, which the respondent accepts or rejects. If the initial bid is accepted, the interviewer revises the bid upward until a final value is reached. If the initial bid is rejected the initial bid is revised downward until a final value, which can be zero (or in principle even negative) is reached.

3.2.1. The Sample Design

In order to ensure homogeneity in the grouping of households, the sample for the study area is derived from three strata, Ward I, Ward II and Ward III. These three wards make up the entire Makeni Town. Hence, a stratified sampling was used and subsequently, a systematic random sampling technique was also employed to obtain the sample size, which is believed to be a representative of the population of households in the selected stratum. Tariff figures and the cost of providing water were obtained from the SALWACO office as such information provides the opportunity to evaluate the appropriate cost recovery system by determining how much people are willing to pay and how much it costs to supply the water.

3.2.2. The Questionnaire Design

The preparation of the CV Survey questionnaire generally followed the Mitchell and Carson techniques (1989), with the required modification that adapts it to the study area. The questionnaire was conducted face to face and contained 33 questions for the three parts of the CVM framework. The questionnaire included an opening preamble paragraph that explains why the study is conducted (see Appendix 1). It is believed that this opening paragraph will reduce strategic bias.

Preceding the valuation question on the WTP section of the questionnaire, the enumerator explained to the respondent about the features of a modern piped water supply system, that is one that will be available for 24 hours a day, 365 days a year on demand and that water from the tap does not require any further treatment but this involves payment. The enumerator will then ask

the respondent if they are interested in the new system. If the answer acquired is YES, then the next question is the monetary valuation question, which can take the form of checklist or bidding.

3.2.3. The Survey Procedure

Most of the fieldwork for this research was devoted to the design and implementation of a household survey, the primary purpose of which was to collect information about the existing water problems and households' WTP for improved water services in Makeni Town. The fieldwork started with the procurement of a map of Makeni from the Ministry of Lands and Survey in Freetown. With the help of Town Council officials, the old map was given a facelift to reflect present delineations of the Town and the essence of this was for the researcher to get a sampling frame.

The enumerators were trained on the 26th and 27th of December 2002. The enumerators employed in this study were high school graduates and this was the reason the training was extended to a second day. Enumerators were instructed in the precise translation of the questionnaire into ***Themne*** and ***Creole***[6] and were trained on how to ask questions and elicit answers.

A pretest of the survey questionnaire was carried out on the study area between the 28th and 31st of December 2002. It is believed that the pretest will help to determine, the suitability of the questionnaire (the organization and wording of the questionnaire), the appropriate values that would be included to make up the WTP aspect of the final survey questionnaire, and also to help the trained enumerators have a practice in administering the questionnaire.

6. Themne and Creole are the two languages widely spoken in the area of study

The pretest results indicated that the structure of the questionnaire was good except that the respondents prefer ***havolin***[7] as a unit of measurement instead of gallons since they are more acquainted with the use of the former. In the iterative bidding and checklist formats, the bids or starting price were selected on the basis of results obtained in the pilot survey, which had an open-ended format. People interviewed during the pretest were excluded from the final survey. The principal researcher and the enumerators visited all major areas of the Town and the exercise received the full blessing of the Paramount Chief (traditional ruler of the area).

Following the successful completion of the pretest, a final questionnaire was structured and the real household survey kicked off on the 3rd of January 2003 and it lasted for ten days. The principal researcher with the help of four enumerators and a field supervisor administered 300 questionnaires. The principal researcher and the field supervisor use motorbikes to return to selected respondents after the enumerator reportedly completed the interview in order to verify that the enumerator had in fact interviewed the correct household and that the interview had taken place as reported.

3.3. Model Specification

To investigate the determinants of households' WTP for improved water services, the study employs two different types of multivariate models involving the Tobit model and a discrete

7. A havolin is a five-gallon container that is used popularly in Sierra Leone to measure palm oil, palm wine, nut oil e.t.c.

choice model, probit or logit [8]. There are practical reasons for favouring either the Probit or Logit models in some cases for mathematical convenience, but it is difficult to justify the choice of one distribution or another on theoretical grounds. Amemiya (1981) discusses a number of related issues, but as a general proposition, the question is unresolved. In most applications, it seems not to make much difference.

The essence of estimating a qualitative choice model (probit or logit) is that, unlike the generalized tobit which analyse the dichotomous variables as they are, with the probit or logit models, we assume the existence of an underlying latent variable for which we observe a dichotomous realization. For instance, if the observed dummy variable were whether or not the respondent is willing to connect to the new system, then AC_i would be defined as "desire or ability to connect to the promised system".

It must be noted that in both models, there is desire and ability involved. Hence the explanatory variables in the Tobit model would contain elements that explain the respondents' decision of whether to be interested in the promised system or not. In brief, the generalized Tobit model identifies the determinants of WTP while the probit model indicates how these determinants aid in making a decision as to whether to connect or not to the promised system.

8. These models are used to estimate the valuation function and are classified under the direct techniques of estimation.

3.3.1. Discrete Approach

This approach offers an alternative theoretical framework to the OLS approach (The World Bank team 1993). The OLS approach is unable to address individual preferences between the old and the anticipated new system. This approach yields the marginal effects of the independent variables on the dependent variable directly, hence providing the analyst with lucid view of the significant effects of the explanatory variables on the dependent variable. We assumed that the probability that an individual or household will make a particular choice is a linear function of the individual or household attributes. With this in mind, we estimate a qualitative choice model, Probit, which will provide a suitable means of estimating the slope and the intercept parameters of the relationship between the index and the household attributes.

Let us consider the decision of a household regarding whether the household prefers the improved system or the old system. During the period in which the survey was undertaken, the respondent is either interested in the new system or not. We assume that the utility associated with each of the systems is a function of the characteristics of the system and according to the World Bank team, these set of factors include, age, sex, income, educational level and so on.

The probability of choosing a system can be expressed generally in equation form as:

$$\text{Prob}\,(AC_i = 1) = F(\beta X_i) \quad \text{---------- (2)}$$

$$\text{Prob}\,(AC_i = 0) = 1 - F(\beta X_i) \quad \text{---------- (3)}$$

The set of parameters, β, reflect the impact of changes in X on the probability. We are interested in knowing the marginal effects of the set of factors on the probability of connecting to the improved system.

Devising a suitable model for the right hand side of the equation yields: $F(Xi, \beta) = \beta Xi$

Since $E(AC_i) = F(Xi, \beta)$, we can construct the regression model,

$AC_i = E(AC_i) + \{ AC_i - E(AC_i)\}$ ---------- (4)

$AC_i = \alpha + \beta Xi + \varepsilon$ ---------- (5)

Where AC_i is not observed but represents the probability of choosing one of the systems of water facilities.

X represents a vector of household attributes, α and β are the intercept and the coefficients of the attribute variables respectively. The qualitative choice models solve the problem of estimating α and β, while at the same time obtains information about AC_i.

When a household is faced with a choice between the two alternative water systems, the response will either be YES or NO. If the household prefers the new improved water system, the dummy variable (AC_i) will assume the value of one and if the old system is preferred, then the dummy variable will assume the value of zero. The basic assumption is that the ith household connects to the new system if $U_{ns} > U_{os}$ and failed to connect if $U_{ns} < U_{os}$.

Where NS represents the new water system and OS denotes old water system. U_{ns} and Uos is the ith household indirect utility derived from new water system and old water system respectively.

ε is assumed to be normally distributed with a mean of zero and variance of one.

It is important to understand the issue of the latent variable. AC_i can be observed in two states i.e. a respondent is either interested in the new system or not. However, not all respondents have the same willingness to connect to the new system. One respondent might perceive the present water

quality as satisfactory while another might perceive it to be poor but both of them are willing to connect to the new system. In both cases we observe that $AC_i = 1$. While we cannot directly observe AC_i at some point, a change in AC_i results in a change in what we observe, like whether the respondent is interested in the new system or not. For instance, as the income of an individual increases, all things being equal, it is reasonable that the individual's propensity to be interested in the promised system will increase. This propensity at some point would cross a threshold that will result in a decision to connect to the improved system.

With the assumptions of the qualitative choice models mentioned above, the following model is used to estimate household probability of choosing the new water system.

$$Pi = \alpha_0 + \alpha_1 GEN_{i1} + \alpha_2 EDU_i + \alpha_3 DIS_i + \alpha_4 AGE_i + \alpha_5 INC_i + \alpha_6 Wq_{i2} + \alpha_7 RES_{i3} + \varepsilon \text{ ---------- (6)}$$

Where Pi is the probability that the respondent will choose the new system, and all other variables and their expected signs are as defined in equation 8 below.

When using either the probit or logit model with individual observations, the most suitable estimation technique is Maximum Likelihood[9]. The basic assumption here is that the distribution is normal. This technique has a number of desirable properties. All parameter estimators are consistent and efficient asymptotically. In addition, all parameter estimators are known to be (asymptotically) normal so that the analog of the regression t- test can be applied. Also, the likelihood-ratio test can be used to test the joint significance of the coefficients.

3.3.2. Tobit model

Although most times rural households are willing to pay little or nothing for improved water services, the a priori expectation is that several factors do affect the WTP for improved water services. These factors among others include, family size, gender, level of education, income of

the household, distance covered to fetch water, attitude towards the provision and management of improved water services, water quality and water reliability, e.t.c, (Whittington *Et al* .1993).

9.For further details, see Econometric models and economic forecasts by Pindyck and Rubinfeld (1991).

We can specify the following Tobit model based on the factors identified above. This study looks at the WTP behaviour using a systematic random sampling of the population of Makeni. For those who happened to express their WTP, we recorded their potential expenditures; but for those who did not express their WTP, one have no measure of the maximum amount that they wre WTP at the time of the survey.

The dependent variable, WTP is therefore censored, i.e., information is missing for the dependent variable, but the corresponding information for the independent variables is present. Thus, OLS estimation of this kind of model will lead bias and inconsistent parameter estimates. The underlying continuous version of the model is given by:

$WTP^* = \alpha + \beta X_i^* + \varepsilon_i^*$

WTP* represents the expressed WTP or the reservation WTP for those who refused to express their WTP. X* represents a vector of socioeconomic variables. For those respondents that failed to reveal their WTP, WTP cannot be measured and is set equal to zero. Hence the observed dependent variable is given by:

$WTP = WTP^*$ for $WTP^* > 0$

$WTP = 0$ for $WTP^* \leq 0$

The actual estimated equation will then appear as follows.

$$WTP_i = \alpha_0 + \alpha_1 INC_i + \alpha_2 AGE_i + \alpha_3 AGE_i^2 + \alpha_4 EDU + \alpha_5 GEN_{i1} + \alpha_6 HHS_i + \alpha_7 RES_{i2} + \alpha_8 HOH_{i3} + \alpha_9 Wq_{i4} + \alpha_{10} NYR_i + \alpha_{11} DIS_i + \varepsilon_i \text{----------} 8$$

For least squares to be unbiased and consistent, ε_i must equal zero. But we know that WTP≥0. It follows directly that $\varepsilon_i \geq -\alpha - \beta X_i$.

For a positive mean, the probability distribution density function of the censored error term is;

$$f(\varepsilon_i^*) = f(\varepsilon_i / \varepsilon_i \geq -\alpha - \beta X_i) = \frac{f(\varepsilon_i)}{\int_{-\alpha - \beta Xi}^{\infty} f(\theta) d\theta}$$

Where, WTP_i is the willingness to pay for improved water services by respondent i. This variable is expressed in monetary terms and as a monthly payment.

INC: this is the total household income per month. It is included to capture the effects of income on improved water services in Makeni. It is expected that households with higher income have a greater ability to pay and a greater preference for improved water service. Above all, assuming water is a normal good, economic theory postulates that income and quantity demanded are positively related.

AGE represents the age of the respondent. Older household heads are used to free water services either from traditional wells or public facilities. Hence, they may be unwilling to pay for a new water service. Therefore a negative relationship is expected between age and WTP for improved water supply.

EDU is the educational level of the respondent. It is measured as the number of years of schooling. Many studies including Briscoe *Et al*, 1990 and Aguilar and Sterner, 1995, have shown that education is very important in explaining variations in WTP among respondents.

Education is quite crucial for an understanding of the importance of clean water for diseases and thus we will expect the educational level, as in earlier studies, to be positively related with the WTP.

GEN: this is an intercept dummy variable that represents the gender of the respondent. One is for female respondents while zero is for male respondents. Women in general have the main responsibility for using water in cooking, cleaning, and also to take care of the children when they are sick. As a result of these reasons, women are expected to have a higher WTP than men for an improved provision of water supply. Since the benchmark is male, the coefficient of GEN will be positive if the females are more willing to pay than the male counterparts and negative if the females are less willing to pay than the males.

HHS is the household size, measured as the number of people in the household. Large families have more children but a stronger budget constraint, and thus the net effect is difficult to judge. According to earlier studies, including Boadu, 1992, a positive relationship is expected to dominate between family size and WTP for public standpipe water and a negative relationship for a private connection. The majority of the households in the study area tend to have larger family sizes. It seems obvious therefore that they might favour public stand posts in order to pay less. At the same time, they might use the family labour to fetch water from neighbouring sources thereby reducing their WTP, but if this labour cannot be used to collect water, then such families will have to increase their WTP. Thus the sign is indeterminate.

RES represents a dummy variable measuring who the respondent thought should shoulder the responsibility of water supply management. One represents the views of those who think that

government should provide and manage the improved water facilities and zero represents the views of those respondents who believe that private household and /or community should undertake the responsibility. If the residents believe that government should provide safe drinking water, they will be less willing to pay for an improved water service. Hence an inverse relationship is expected between WTP and management.

HOH; is an intercept dummy variable that represents the status of the respondent. One denotes the head of household and zero denotes any respondent within the household other than the head of the household. Since the head of the household is the person who has the responsibility and thus knowledge about the family budget, the head is therefore expected to have a lower WTP than other household members. In this case, the coefficient will be negative.

WQ is another intercept dummy variable representing the quality of the existing water sources. One is the value for perceived good quality and zero represents perceived poor quality. The continuity and the quality of the present water service should be negatively related with WTP if the household is already satisfied, as that household will not be willing to spend more money on water services.

NYR represents the number of years in residence. An individual who has lived in a given area for a long period of time and is used to paying nothing or low rates for water supply would be less willing to pay for an improved service. On the other hand, a long term resident that has witnessed persistent water supply problems may be more willing to pay for an improved service. Hence the sign of the coefficient of this variable is expected to be indeterminate.

DIS stands for distance covered to collect water from a given source. This variable is expressed in metres to denote the distance covered by respondents to get water from nearby water wells in the event they do not own one. A positive relationship is expected between DIS and WTP for an improved service that will ensure less distance to be covered to fetch water from a given source.

ε represents the error term to capture the influence of all omitted variables.

3.4. Data Analysis

The study uses both univariate and multivariate techniques to analyze the nature of the explanatory variables included in the model. Univariate analysis includes mean-based statistics such as mean and standard deviation.

From the final WTP bids, we shall calculate, the mean, median and total WTP. The total WTP will represent the value of the good to the household for improved water services. From the calculations, WTP from the sample can be generalized for the population of Makeni. It must be noted that the calculation of the aggregate WTP is based on the estimated number of houses[10] in Makeni due to the fact that about 80 percent of the respondents expressed their WTP in terms of the house rather than the household.

The aggregate WTP estimates can be obtained by two approaches. One is to assume a zero WTP for those who failed to respond to the WTP section of the questionnaire (Bishop and Boyle, 1985,

10.The decision to use houses instead of households is that different households living under the same roof make collective decisions affecting all of them and above all almost all rented houses in this Town are not divided into apartments. Thus it is common to find three different households occupying a six-bedroom house.

as cited in Bah's work). Another approach is the weighted regression used to obtain consistent estimates of the coefficient parameters and WTP. The basic assumption here is that non-response is random and that non-respondents have WTP equal to that of the respondents who shared similar characteristics. Therefore with a zero non- response rate, the mean values shall be used to calculate the total WTP for the study site.

Descriptive statistics involving the use of cross tabulations are used to explain the relationship between WTP and some of the explanatory variables. The fitness and the overall significance of explanatory variables will be examined by using the t or z-test.

As aforementioned, the Tobit model is used to explain the determinants of WTP bids while the probit model is used to analyse the YES/NO response. The latter assumes that the responses to the questions only provide an ordering of preferences of respondents i.e. if one respondent answered YES to a WTP question and another respondent answered No, the only information that is assume to be obtained from these responses is that the first respondent was WTP more than the second.

CHAPTER FOUR

DISCUSSION OF RESULTS

4.1 Overview of the Study Area

Makeni Town is located 114 miles Northeast of Freetown, and it headquartered the Northern Province (the biggest province in Sierra Leone). Makeni Township had a population of 49,038 as at 1985 census. This population is 1.39% of the total population of Sierra Leone. As at 1985, the growth rate of the population of Makeni Town was 5.50%. Hence the population was projected to be 103,800 in 1999. But it must be noted that this growth rate was no longer tenable because of the massive movement of people due to the rebel skirmishes that rocked the country between 1991 and 2001. Thus even the policy makers do not know the exact population of Makeni at the moment.

The estimated number of houses according to the Town Council is 4000. The majorities of the inhabitants are petty traders (about 40%), followed by teachers, civil servants, members of the armed and police forces, small-scale farmers and Non Governmental Organizations workers.

The general water supply situation in the Town at the moment is largely from traditional water wells (see appendices 10 and 11), few open diameter wells with hand pumps, streams and rainwater during the rainy season. On the demand side, it is only dwelling houses and places of worship that use the available water, as there are no industries in the Town.

4.2 Brief History of the Sierra Leone Water Company (SALWACO)

In 1961, the Guma Valley Water Company (GVWC) Act was enacted to provide potable water supply to the greater Freetown area. In 1963, the Water (Control and Supply) Act was enacted, giving control of all water resources of the entire country excluding the greater Freetown Area to the Water Supply Division (WSD) of the Ministry of Energy and Power headed by a chief Engineer.

In 1964, the Government of Sierra Leone (GOSL) concluded a loan agreement with the French Government to set up water supply facilities in 42 urban centres. Degremont Water Supply System was responsible for setting up of the necessary infrastructure. This system operated for some time and ceased functioning mainly due to lack of funds to provide the necessary spare parts, lubricants and fuel. In 1989, GOSL adopted the recommendations of a joint World Bank/WHO study of the Country's Water Sector conducted in the early 80's and established SALWACO to take over and commercialize the operations of the Degremont Water System. This was enacted by Parliament (CAP 37 (88) of 31st August 1988). The initial operational areas of SALWACO were Makeni, Bo, Kenema and Lungi.

At Makeni, the thermal[11] water station at the foot of the Wusum Hill has its source from the Konsho River, seven miles away from Makeni. Raw water is pumped to the dam at the foot of the hill, few metres away from the Water Station. A total of six thousand gallons of diesel fuel per month is needed for both the pumping and treatment of raw water for consumption.

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11. Thermal means the pumping and treatment of water by the use of electrical generators and water pumps.

The distribution network in Makeni is made up of 7km assorted diameter pipes. But Degremont Water System drew up this network plan in the 60's and there has been no extension of the network regardless of the town's expansion. This was one of the factors that limited the revenue generation capacity of SALWACO.

SALWACO used two types of water rates in Makeni: general water charges and water rate.

(a) The general water charge is compulsory to all houses irrespective of whether they are connected or not. These charges are paid because of the presence of water supply in the Township. This fee was Le1000.00 per house and it is only the house head that is targeted.

(b) Water rate is levied to only houses with connections. This charge even though it was flat, it varied according to the number of water points available in the house. The charge for a house with a single stand post was Le4500.00 and an additional Le1500.00 for any other opening. But the medium term objective according to the Chief Engineer is to introduce the meter system. The maximum output of water per day was one million gallons.

At the moment, SALWACO is frantically working to change the thermal system to Gravity[12] because of the high cost associated with the former. Generally, such sources of water require very little treatment and it normally involves chlorination. According to the Regional Water Engineer, even though the gravity system is cheaper, much sensitisation needs to be carried out so that the community can meet its financial obligations, as this is the only way the new system can be

12. This system does not require the use of electrical generators - the water is collected from an elevated position like a spring to a lower level through a collection chamber.

sustainable. For instance, SALWACO never collected rates above Le1.5 million per month due to poor cooperation from the consuming public. A case in point was the religious places; almost all of them that were connected failed to honour their bills. As a result of the shortfall in revenue collection, SALWACO had to embark on water rationing because of the inability to meet basic running cost. What exacerbated the situation was that GOSL was unable to provide the necessary fuel and other materials.

4.3 Socioeconomic Profile of the Sample

A total of 283 households were interviewed. The respondents interviewed that were household heads were 85.2 percent, while the remaining 14.8 percent of the respondents were just members of the households. The later set of respondents was only interviewed in the absence of their household heads. The number of male-headed households was 195 and the remaining 88 were female-headed households. Such a ratio is not surprising considering the social set up of Makeni were men dominate most household decision making. The household respondents who perceived the water quality to be poor were 59.3 percent and 40.7 percent perceives it to be good. According to the survey findings, 115 household members suffered from water related diseases like cholera and diarrhoea during the year 2002 alone. The number of houses with traditional water wells was 143, while 140 rely on the good will of their neighbours, 93.8 percent of the respondents believe that it is the responsibility of the government to provide water supply while the remaining 6.2 percent hold the view that water must be provided by NGO's and the community. A considerable number of the respondents, 37.8%, were illiterates, and 13.9 percent completed tertiary education. This ratio is reflective of the current educational levels in the area

i.e. Northern Province of which Makeni is the headquarter town is the least region in terms of school enrolment in Sierra Leone. The mean WTP per month is Le3000.00 and the mean WTP per connection is Le6000.00. The mean WTP per ***havolin*** from the survey findings is Le 87.00. The mean monthly earning is approximately Le 100,000.00 and it is to a very great extent a reflection of the earning power of a good number of Sierra Leoneans. There is one household with a minimum of only person and the maximum is 24. The average family size is 14.39. The average age, average distance between the residence of the sampled households and their water sources are 45.6 and 76.5m respectively. The average family size figure might not be realistic due to the attitude of the respondents, i.e., they tend to give the population of the house instead of that of the household.

A list of means, standard deviations, maximum and minimum values of selected independent variables for the entire sample is presented in Appendix 2.

4.4.1 Analysis of WTP bids per *havolin*

No matter what sampling plan and survey method used in a CV, some level of non-response to the WTP questions is virtually inevitable, with the consequence that the number of those who give valid WTP amounts will be smaller than the number of originally chosen sample elements (Mitchell and Carson). This study is no exception as it suffers from item non-response[13].

In CV surveys, however, according to Mitchell and Carson, non-response rates of 20 to 30

13. Item non-response refers to a situation where the respondent answers some or most of the questions on a survey but fails to answer a particular question of interest such as WTP question.

percent for the WTP elicitation questions are not uncommon where the sample is random and therefore includes people of all educational and age levels. The CV survey indicates a non-response rate of 9.5 percent as shown in table 1. These item non-responses were as a result of poverty and refusals. About 40 % of those who refuse to reveal their WTP for the improved water system consider it to be a gift from God (protest votes). The remaining 60 percent of the non-responses are as a result of marginal incomes- the results are presumably dependent on poverty and not on free riding behaviour. Thus the latter set of zeroes could be considered as true zeroes.

Taking a cursory look at Table 1, one discovers that the modal WTP per ***havolin*** is Le10.00, 23 percent of the entire sample, followed closely by Le50.00 (22.3%), then by Le20.00 (14.5%) and Le 100.00(14.8%) respectively. But looking at the current economic trends in the country Le 10.00 is no longer a useful figure for any form of transaction. Hence Le 50.00 is the least reasonable figure obtained from the survey.

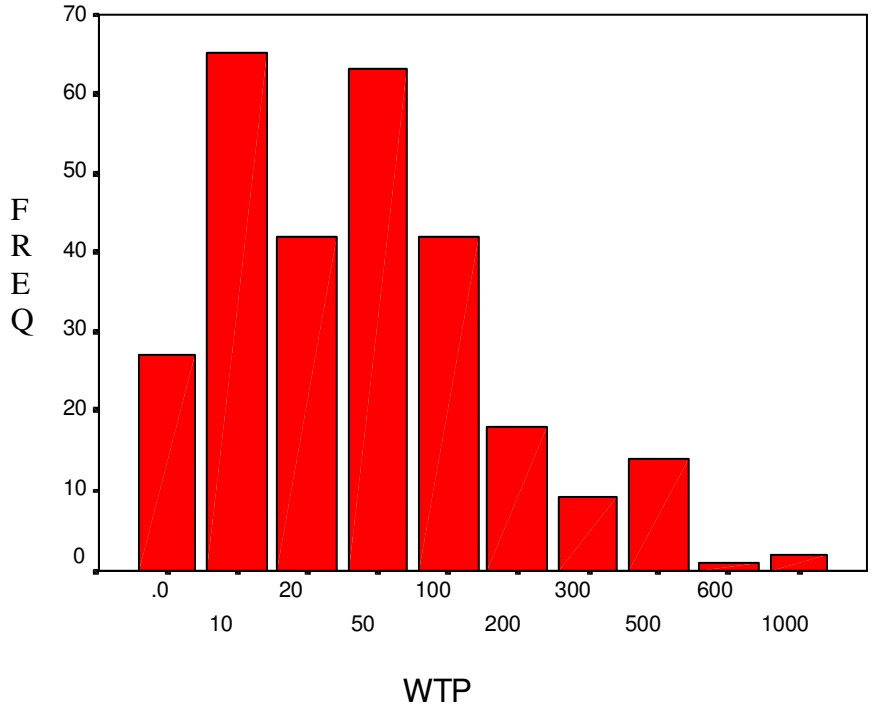
Table 1: WTP per *havolin*

WTP figure	Frequency	Valid percent	Cumulative percent
0.00	27	9.5	9.5
10.00	65	23.0	32.5
15.00	1	0.4	32.9
20.00	41	14.5	47.3
50.00	63	22.3	69.6
100.00	42	14.8	84.5
200.00	18	6.4	90.8
300.00	9	3.2	94.0
500.00	14	4.9	98.9
600.00	1	0.4	99.3
1000.00	2	0.7	100.0
Total	283	100.0	

Source: Survey Data

Figure 1 also helps to elucidate the above explanation.

Figure 1: WTP frequency distribution (Leones / *havolin*)



4.4.2 Analysis of WTP bids per month

Table 2 shows the respondents' WTP per month. It is clear from the table that the modal WTP is Le3000.00 per month, 19.4 percent. What is interesting is that this figure is below the old rate levied by SALWACO. The respondents who are only willing to pay Le1000.00 per month is 16.1 percent while 15 percent of the respondents are willing to pay Le2000.00 per month. What is also clear is that only 27.5 percent of the respondents are willing to pay more than the old tariff with some willing to pay as high as five times the old price.

Table 2: WTP per month (in Leones)

WTP amount	Frequency	Valid percent
0.00	27	9.5
1000.00	44	16.1
1500.00	26	9.5
2000.00	41	15.0
2500.00	7	2.6
3000.00	53	19.4
3500.00	1	0.4
4000.00	10	3.7
5000.00	38	13.9
6000.00	7	2.6
7500.00	1	0.4
9000.00	1	0.4
10000.00	14	5.1
15000.00	2	0.7
20000.00	1	0.4

Source: Survey Data

The figure in Appendix 3 also aids to explain the patterns of respondents' WTP per month for an improved service of water.

Table 3 categorizes the monthly WTP figures obtained from the survey into six ranges along with the means of some of the socioeconomic variables used in the model. This cross tabulation of the WTP responses with some of the socioeconomic variables can be used to determine whether different groups of households in the sample respond differently to the WTP valuation question.

As the mean educational level of households for each category increases so is the WTP for improved water service. Although the pattern of increase is not continuous but what can be

inferred is that the respondents with the highest level of education are willing to pay more than their counterparts with the least level of education. The picture on the age of respondent and the WTP does not indicate any specific direction. Although the relationship between monthly income and the WTP of respondents is not too specific, but one can realize that individuals with high income are more willing to pay than their counterparts in the lower income brackets. However, the cross tabulation doesn't indicate a uniform relationship between WTP bids and household size and distance from current source of water. The sex of the respondent does not seem to abide with theoretical predictions that females are more WTP than their male counterparts. This might be due to the fact that we are dealing with means and above all the number of men interviewed far outweighs the number of women.

Table 3: Cross tabulation of WTP with some explanatory variables

WTP groups	0 to 2000	2001 to 3000	3001 to 4000	4001 to 5000	5001 to 10000	10000 and above
Educational level of the respondent	6.16	6.68	6.18	9.62	7.83	11.38
Age of respondent	44.24	49.37	46.55	44.08	45.39	47.75
Monthly income of household head	101857.14	92645.16	101818.18	97256.41	116130.43	132250.00
Distance from current source of water	77.32	78.55	108.64	91.28	47.39	14.38
Household Size	14.28	14.65	16.64	14.92	12.17	15.38
Sex of respondent, 1 for female and 0 for male 0	97	38	9	24	15	5
1	43	24	2	15	8	3
Total	140	62	11	39	23	8

Source: Survey Data

The above cross tabulation gives us some insights into the determinants of households' WTP for improved water services.

4.5 Comparison of Techniques

In this section we try to compare the various methods used to obtain the WTP figures and to decide whether the method of approach has influence on the WTP figures arrived at or not.

Table 4: Mean WTP of the various elicitation methods

Elicitation technique	N	Minimum	Maximum	Mean
WTP from the checklist	147	.00	400.00	46.7347
WTP from the high bid	67	.00	1000.00	230.8955
WTP from the low bid	69	.00	500.00	33.3333

Source: Survey Data

It can be seen from table 4 that the iterative bidding estimate is affected by a starting point bias. The starting points for the low and high bids were Le10.00 and Le1000.00 respectively. While the minimum value for all the three formats is zero, the maximum value is not the same. The maximum value is Le1000.00, Le500, and Le400.00 per ***havolin*** of improved water from the high bid, low bid and checklist respectively. The high bid has the highest mean WTP per ***havolin***, Le230.00, followed by the checklist, Le46.00 and the low bid, Le33.00. The same pattern is also depicted by the graphical representation shown in Appendix 4.

The figure in Appendix 5 also suggests that the starting point does indeed affect respondents' final bids for both the low starting point and the high starting point. It is clear from the graph that the mean frequency from the high bid WTP per ***havolin*** is higher than the mean frequency from the low bid WTP per ***havolin*** for all the prices. What is also clear is that the number of zero bids is higher from the high bid as compared to the low bid.

4.6 Tests for Starting Point Bias

In a bidding elicitation format, the enumerator starts questioning the respondent at an initial price. The initial starting point in bidding game can significantly influence the final bid, i.e., the choice of high or low starting point may lead to high or low mean WTP (Bateman and Turner, 1993). In this research, one set of respondents were asked a low starting point, Le10.00 per ***havolin*** of improved water and another set were asked a high starting point,

Le 1000.00 per ***havolin*** of improved water. The difference between the mean WTP for the two sets were tested by using Larson's formula for calculating Thayer's two-tailed t-test comparing the null hypothesis H_o: $X_1 = X_2$ against the alternative hypothesis H_1: $X_1 \neq X_2$ is given by:

$$T = (X_1 - X_2)/\{S_p \sqrt{\ } (1/N_1 + 1/N_2)\} \quad \text{----------9}$$

$$\text{Where } S_p^2 = \{(N_1 - 1)\, S_1^2 + (N_2 - 1) S_2^2\}/\{N_1 + N_2 - 2\} \quad \text{----------10}$$

The two- tailed t-test calculations are shown in Appendix 6.

The calculations in Appendix 6 yield a T value of 9.01 and the t- critical is 1.645 at 5 percent level of significance. Hence, the t calculated value is greater than the t critical indicating that the difference between the mean WTP of the two starting point bids is significantly different from zero. This test result implies that we reject the null hypothesis that there is no starting point bias. The implication for such a starting point bias is that the true value of the good is not reflected in the responses obtained from the survey. Despite this conclusion, it must be noted that if a respondent's WTP bid reflect his or "true" value of the good or service, then it should not matter what initial amount or starting point the enumerator uses to begin the game.

4.7 Calculation of Mean WTP

The calculation of the mean WTP from responses commonly involves the omission of protest votes (Bateman and Turner, 1993). If the respondent thinks that he should not pay for the good, purely not for poverty reasons, resulting to a zero WTP, it must be treated as a protest vote and should be deleted. In order to arrive at the overall WTP for Makeni Town, the study shall use the mean WTP per month and aggregating it over the total number of houses in Makeni, the total monthly WTP is arrived at.

The mean WTP after the deletion of the protest zero bids is Le3500.00 (to the nearest hundred). The key significance of this result is that it is below the old rate which was Le4500.00 implying that people are less willing to pay. Thus the overall WTP for Makeni Town is Le3500*4000 =Le14000000.00.

With the a figure of Le14 Million per month, the implication is that if all houses cooperate fully, the amount of revenue generated per month can be very close to ten times the previous figure. Hence, even with the old system, the water supply would have been sustainable if the community was fully prepared to honour its financial obligation.

4.8 Analysis of Regression Results

Multivariate analysis may provide better information and clearer focus on the factors that affect the WTP responses such that policy recommendations can be based on firm conclusions.

Both the probit model and Tobit models as specified in the previous chapter to analyze the explanatory variables that influence households' WTP for improved water supply used in this

research. In addition to the probit and Tobit models, the research also obtains estimates for both the probit model and OLS by Heckman's two stage maximum likelihood, which is similar to the generalized Tobit model and the results are shown in Appendix 8.

The simple rule that is applied to the probit and OLS model is that WTP is only observed when it is greater than zero. Thus, the two decisions are related, i.e., a respondent can only be WTP when he is interested in the improved system. As a result, separate OLS regression of WTP on its determinants; using only data for respondents whose WTP is greater than zero produces inconsistent parameter estimates as a result of selection bias (Greene 1995). The bias arises from the fact that if we only consider observations greater than zero and omit the others, there is no guarantee that E (Ui) will be necessarily zero, and there is no guarantee that OLS estimators will be unbiased. Since nine percent of the observations are zeros, the Heckman model can also be used as a means of estimation to back up the Tobit model. The assumption here is that the error terms of the participation equation and the latent variable are correlated (Amemiya, 1984).

Following Heckman, the first is a probit analysis representing the probability of choosing one of the systems of water facilities. It is based on the entire sample and estimates the probability that a household will connect to the improved system. The coefficients derived from this equation are used to calculate the Inverse Mills Ratio (IMR), which is entered as a regressor in the second equation. The IMR therefore captures the residual (or unobserved) effect of variables relating to the probability of connecting to the new system on the dependent variable of interest, namely households' WTP for improved water services. This latter equation estimates households' WTP exclusively for those whose WTP is greater than zero.

Such alternative presentations help to examine whether or not the WTP bids are related to the explanatory variables or not. The econometric programme, Stata 7.0 is used for estimation purposes. In the Tobit and Heckman models, the marginal effects indicate the impact (magnitude) of a small change in the explanatory variables on the choice probability.

The essence of estimating both equations is that the respondent is involved in making two decisions at the same time, i.e., when the respondent expressed a positive answer to be part of the new system, he is automatically prepared to pay some money for the new improved water system. The nature of the Sierra Leonean currency meant that the WTP figures and income were very large in magnitude as compared to all other variables, rendering the model difficult to estimate. These variables were thus scaled down by 1000 during the model estimation.

The likelihood ratio index (LRI) can be used to measure the goodness of fit and this value normally lies between zero and one. According to Greene (1993), the range of values has no natural interpretation but as LRI approaches one, it represents an improvement in the goodness of fit.

χ^2statistic of the Likelihood Ratio shows the overall model has a good fit and that the overall model is significant at the 5 percent level and the LRI is 51.73. All the variables in Tobit and Heckman selection models have the required a priori signs. The positive coefficients for education, income and water quality in the probit implies that as these independent variables increases, there is the probability that WTP will also increase. The coefficients for responsibility, number of years in residence and age are negative implying that as these variables increases, WTP will decrease. The implication of including age and age squared is that the former is non linear with the dependent variable.

Mitchell and Carson highlighted the problem of outliers in CV studies, and advocated the use of robust estimators as a way to control the potential bias from this source, in preference to adhoc deletions. In line with this idea, this research runs Tobit robust estimation. This form of regression is also used to reduce the effects of heteroscedasticity. Table 5 shows that, heteroscedasticity might be present in the data, and the robust regression results shown in Table 6 are also similar to the Heckman robust estimation results shown in Appendix 8 both qualitatively and in significance levels.

Table 5: Cook-Weisberg test for heteroscedasticity using fitted values of WTP

Ho: Constant variance
Chi^2 (1) = 61.78
Prob > chi2 = 0.0000

The estimated WTP model was also tested for problems of multicollinearity because it was shown by previous researchers (Whittington *et al,* Aguilar and Sterner) that a number of socioeconomic variables used might be highly correlated. This was accomplished by computing the correlation coefficient matrix for the independent variables. The results indicate that multicollinearity is not a serious problem that affects the data set. According to the rule of thumb, multicollinearity becomes a serious problem when R^2 is greater than 0.8 (Gujarati, 1995). The correlation coefficient matrix in appendix 6 shows that the highest R^2 is 0.207.

Micro data in most times are also not devoid of problems of non-normality. Therefore, a test based on the skewness and kurtosis is carried out. The analysis shows that skewness is met while the kurtosis assumption is unmet. Skewness refers to the asymmetry of a distribution

while kurtosis refers to the flatness or tallness of the tails of the distribution. For symmetric distributions, skewness is equal to zero.

The Pseudo R^2 value for the model is 0.31. Although this value indicate that much of the variation in the WTP bids cannot be explained by the model, this value is not unusual for cross sectional data from CV surveys and one can also compare it with the R^2 value of previous CV studies carried out. The R^2 values reported by Aguilar and Sterner were 0.61, 0.39 and 0.27 for Limon, Guanacaste and Muang Xaithani respectively. Whittington *et al* reported a range from 0.32 for sewer to 0.47 for water in their CV study of Kumasi. Mitchell and Carson suggest that the reliability of a CV study, which fails to show an R^2 of at least 0.15, using only a few key variables, is open to question. Thus the results from Makeni pass the Mitchell and Carson's proposed R^2 criteria.

Table 6: Probit Estimation Results

Dependent Variable, AC_i		
Variable	Coefficient	z-statistic
Education	0.030	3.32***
Water Quality	0.228	4.45***
Responsibility	-0.611	-2.67**
Income	0.009	2.34*
Age	0.004	2.12*
Constant	0.039	8.46***

*** Significant at 1percent level **Significant at 5 percent level *Significant at 10 percent level

Table 6 shows the probit estimation regression results of the determinants of ability to connect to the improved water service in Makeni. From the regression results, the constant term is positive and significant. This indicates that households will associate a value to an

improved water service irrespective of the level of significance of the independent variables specified in the study.

Taking a cursory look at the results, one can see that five variables contributed significantly to the respondents' choice of whether to be part of the improved water system or not. These variables are income, age, responsibility, education and water quality. The implication here is that it is only these five sets of variables that influence the individual's decision of whether to say, "Yes" or "No" to the promised system. During the time of the survey, a good number of the respondents consider the water quality to be poor and above all, the respondents believe that the government should intervene so that they can only pay minimal amounts for the new system. These variables also end up being determinants for the WTP of respondents in the Tobit model.

Table 7: Tobit Estimation Results

Dependent Variable, WTPi		
Variable	Coefficient	t- statistic
Age	0.048	3.83***
Age Squared	-0.023	-2.22**
Education	0.041	2.07**
Income	0.052	2.71*
Water Quality	0.549	7.56***
Responsibility	-1.113	-2.06**
Distance	0.062	3.97***
Elicitation Dummy	0.001	2.01***
Constant	5.325	8.99***
R^2 = 0.31 LR= 20.93Log likelihood=572.04 N = 272 Censored observations = 16 Uncensored observations = 256		

*** Significant at 1percent level **Significant at 5 percent level *Significant at 10 percent level

As expected, the signs of the coefficients of age and age squared of the respondent are positive and negative respectively and significant as indicated in Table 7. The implication is that as the age of the respondent increases, the preference for a continuous use of modern sources of water would increase but at a decreasing rate. The ultimate effect is that young people are more WTP for an improved water service than their elderly counterparts. Elderly people are very much reluctant to express desire for an improved system of water supply that requires payment, as they tend to have the belief that they will not live longer again as compared to the young people. Another related factor is that elderly people most times have larger families as compared to the young ones who have small family sizes.

The education variable is positive and significant at the 5 percent level. The implication is that the higher the educational level, the greater the awareness about the health benefits of improved water supply as well as the opportunity cost of time spent in collecting water from a traditional source. Thus, a household head that is educated is more WTP than a household with little or no educational background. This finding confirms our hypothesis that the level of education is positively related with WTP and it is also consistent with the empirical evidence cited in the literature, Whittington et al, 1998, Bah, 1997; Kamara, 1996 and Aguilar and Sterner, 1995.

The household income variable, INC, has a positive sign and it is significant at the 10 percent level. This finding is in conformity with the general demand theory that income and quantity demanded are positively related except for inferior goods. Hence according to this result, water is not an inferior good. The results indicate that households with high income tend to reveal a high WTP for the promised system than their counterparts with low incomes.

Genanew, Assefa, Bah and the World Bank water demand research team also obtained similar results.

The water quality dummy, WQ, is positive and significant at the 1 percent level. This is in conformity with a priori expectation; meaning that, if the respondent anticipates the future quality to be superior as opposed to the present water quality then his WTP will be high. This variable also conforms to the probit analysis. The justification is that 115 household members suffered from water related diseases for the year 2002 alone. Despite this, it would be recalled that 40.7 percent of the respondents perceive the water quality to be good.

The variable responsibility, RES, has the a priori sign and it is significant. RES is negative because the respondents expect the government to shoulder the full responsibility of providing potable water and therefore their WTP is lower. As a result of this, respondents might have understated their WTP to shift responsibility to the government or to keep the price extremely low. In other words, they perceive that it is in their best interest to undervalue the water service because they firmly believe that this will make the service more affordable for them or shift the burden to the government. This is quiet natural of the people of Makeni Town, as they have the firm believe that it is the government that must provide water at a very little or no cost. The implication from this finding is that there might have been strategic behaviour on the part of the respondents thereby biasing the WTP values.

The elicitation technique dummy, ED, assumes the value of one for the checklist format and zero for the bidding game. This variable is significant and the reason why it turns out to be significant in the Tobit stage of the analysis is that during the time the respondent is making a

decision as to whether to say “Yes” or “No” to the new system, the respondent does not know the elicitation technique he or she will be faced with. It is only after saying “Yes” that the WTP question is asked. Thus the starting point figure also affects the WTP figures obtained in the survey.

Distance, DIS, is positive and significant at the conventional levels; this is in conformity to our a priori expectations. A good number of houses in Makeni own traditional water wells and at the same time others do not, thus some household members need to cover some distance to fetch water. This might explain the significance of this variable on one hand. Again, there are houses located far off from swampy areas and they have to cover some distance to fetch water especially during the climax of the dry season when their water wells become dry. Thus this set of people might be WTP more than their counterparts as the distance they cover increases. However, this result is the same as some previous studies carried out earlier (Bah, Whittington et al and Aguilar). It must be noted that this variable is expressed by most of the writers as “Time spent by the water Carrier”. Even though the nomenclature is different, the effect on the dependent variable is the same. This research simply decides to use “the distance covered” because two individuals can cover the same distance with different time lengths.

The number of years in residence, NYR variable, is not significance at the conventional levels. The implication is that the longer people lived in a particular house, the more reluctant are they to pay for an improved water service. A good number of the respondents have lived quiet long in the homes where the interviews were conducted and some of them were even

born in those homes. Thus their acquaintance with water from the traditional wells is high meaning that their WTP is low.

The other variables that were also not significant and therefore require no further analysis are household head, the gender of the respondent and household size.

Comparing the Tobit results and the Heckman regression results shown in appendix 8 indicates that all the variables in the Heckman are also significant in the Tobit model and the results are very similar except at the conventional levels of significance. Again, from Appendix 8, one can see that Lambda, inverse mill's ratio (IMR), brought forward from the previous estimation is significant implying that the two decisions are related and furthermore, there is sample selection bias when the zero WTP figures are just discarded. There is also marginal evidence of sample selection bias in that athrho is significant at the five percent level. Under full maximum likelihood, the non-selection hazard is derived from the parameter estimates of the selection equation. Table 8 shows the full marginal effects of all the variables.

Table 8: Tobit's Marginal effects

Variable	Marginal Effect	z- statistic
Age	0.008	2.13**
Age Squared	-0.0001	-2.05**
Education	0.001	2.29**
Income	0.012	2.70*
Water Quality	0.249	7.56***
Responsibility	-0.0008	-6.35***
Distance	0.002	8.51***

From table 8, the marginal effect of the dummy variable, responsibility, is –0.0008; the implication of this is that as the respondents' conviction that the government should be responsible for water provision discretely changes from zero to one, the probability of connecting to the new system will reduce by 0.0008. This implied that responsibility plays a crucial role in determining the level of interest of the respondent in the promised system. This does not come as a surprise since the majority of the respondents at the time of the survey pin pointed that the government must shoulder the responsibility of providing improved water at a very little or no cost.

Water quality (WQ) produces a marginal effect of 0.249, meaning that for a discrete change of the dummy variable, quality of water, from zero to one, the probability that an individual will be interested in the new improved water system will also increase by 0.249. This marginal effect is reflective of the descriptive analysis; considering the number of people that suffered from water related illnesses as reported from survey findings.

The marginal effect of income is 0.012. The implication is that a Le1000.00 increase in the earnings of the household will increase the probability of joining the improved water system by 0.012. This follows from basic economic theory that the higher the income of households, the higher the probability of households' WTP for improved water services. As the level of education increases by one year, the probability that a respondent will develop interest in the promised improved water system will increase by 0.001.

The marginal effect of age on the probability of connection is positive but age squared is negative, i.e., when the respondent's age increases by one year, the probability of connecting

to the new system increases but at a decreasing rate. This negative relationship might be due to the fact that old people are conservative to adopt an improved water system that requires payment. It reminds me of the time I was administering the questionnaires, when an old man told me that if the promised system requires payment of US $3 per month, then let him be excluded, as he is quite satisfied with the traditional water wells.

The marginal effect of distance is 0.002. The implication is that for an increase in distance by one meter, the probability of an individual connecting to the improved water system will increase by 0.002. However, these results support the findings of earlier research carried out by Bah, 1997; Boadu, 1992 and Whittington *et al*, 1990.

4.9 Content Validity

In this study, effort was taken to ensure that the wording of the questions did not unduly influence the responses, and furthermore, in order to improve content validity, the survey questionnaire followed the form of Mitchell and Carson. Despite this, a retrospective analysis of the data revealed that there might have been problems for respondents trying to determine if payment were for all house members or simply for family members as some of the respondents openly expressed that payment should be per house or compound instead of household.

4.10 Estimating Expected Revenue

The frequency distribution of WTP bids can be used to provide estimates of the expected revenue from the improved water service. This can be done by the following operations.

Table 9: Expected Revenue from Improved Water Supply

Monthly WTP figure	Freq	% Freq	% of houses can connect	Number of houses that can connect	Expected Revenue
1000	132	17.4	100	4000	4000000
1500	78	10.3	82.6	3304	4956000
2000	129	17.0	72.3	2892	5784000
2500	21	2.8	55.3	2212	5530000
3000	161	21.2	52.5	2100	6300000
3500	3	0.4	31.3	1252	4382000
4000	30	4.0	30.9	1236	4944000
5000	116	15.3	26.9	1076	5380000
6000	21	2.8	11.6	464	2784000
7500	3	0.4	8.8	352	2640000
9000	3	0.4	8.4	336	3024000
10000	44	5.8	8.0	320	3200000
15000	12	1.6	2.2	88	1320000
20000	5	0.7	0.6	24	480000

Source: Survey Data

Predict the total number of houses WTP for an improved water service at a specific price and multiply it by the price (WTP figure per month). Estimation of total revenue allows water utility decision makers in Makeni to determine how many houses can afford the service charge and the expected revenue from the service.

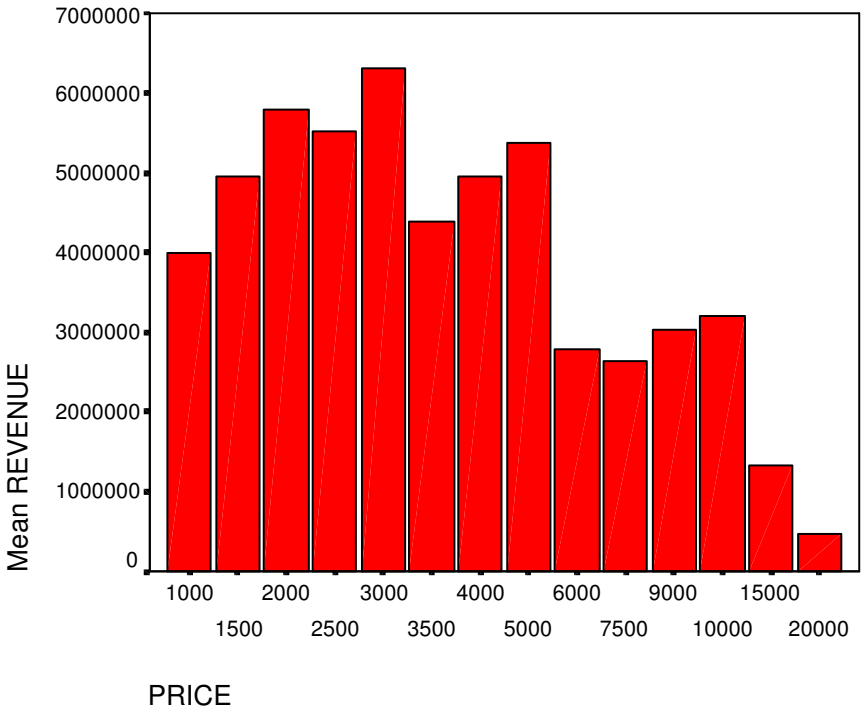
From Table 9, if the monthly tariff is Le1000.00, it is expected that all the houses in Makeni can afford to pay such an amount. Thus when the price is Le1000.00, 4000 houses will connect to the new system; the expected revenue per month is Le4000000.00. When the tariff is increased to Le 1500.00, the revenue generated per month will be Le4956000.00. With a tariff figure of Le2000.00 per month, the monthly revenue is Le5784000.00. If the service

charge is raised to Le3000.00, 2100 houses will connect to the new system and the monthly revenue that will be generated is Le6300000.00. If the service charge is further raised to Le3500.00 per month, the revenue will decline to Le4382000.00. Hence it is clear that the optimal tariff is Le3000.00 per month as this is the charge that yields the maximum revenue per month. Therefore the average price for improved water service per month is Le3000.00 according to survey findings. It must be noted that this figure is 66.7 % of the previous tariff rate of Le4500.00 per month. This finding is in complete contrast of some earlier studies carried out; Lemessa, Aguilar and Sterna and Bah, as they were able to pin point that the figures that generated the maximum revenues were higher than the existing tariff rates during the periods the studies were conducted. What is also interesting is that even though the optimal figure is less than the previous tariff, the revenue generated per month is four times higher than the alleged monthly figure of Le1500000.00 disclosed by the Water Authorities in Makeni. Hence it becomes clear that if all houses were connected and fully observe their financial obligations, the project would have been sustainable even with a lower tariff rate. It must be noted that such a conclusion on project sustainability is based on the potential amount of revenue to be realized and that the full cost of the project could not be evaluated during the time of the survey due to the non-availability of the documents concerned.

From the aforementioned analysis, it is clear that 55.2 % of the houses will connect to the improved system with a tariff rate of Le3000.00. Thus, if the Water Authorities can increase the level of connection, the revenue base will expand and this can improve potable water provision not only for Makeni but also to neighbouring settlements.

The information on table 8 above can also be represented graphically as shown by the bar graph below. It is vividly clear that the modal price or WTP figure per month is Le3000.00.

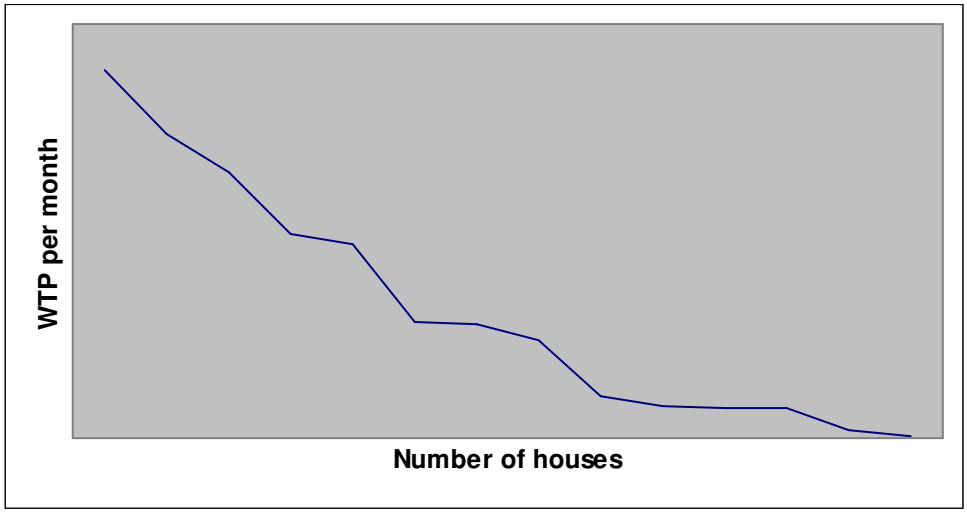
Figure 2: Bar graph showing expected revenue from improved water services



4.11 Aggregate Demand Curve

The information on table 8 (Columns 1 and 5) can be used to plot the aggregate demand curve. Using the maximum WTP bids on the vertical axis and the total number of houses that can connect on the horizontal axis yields the demand curve for improved water services in Makeni.

Figure 3: Demand curve for improved water services in Makeni



Y = -295.84X + 3622.8

Note: If there are many respondents and their reservation WTP figures differ only slightly from one respondent to the other, it is reasonable to think of the demand curve in Figure 3 as sloping smoothly downward.

CHAPTER FIVE

CONCLUSION AND POLICY RECOMMENDATIONS

5.1 Conclusion

The key objective of our research was to determine the WTP for improved water service in Makeni, using the CV method. The implementation of water allocation decision by stakeholders should focus on demand management as opposed to the traditional focus on supply side mechanism. It was for this reason that the study intended to investigate the determinants of households' WTP for improved water service.

The study uses primary cross sectional data obtained from a CV survey conducted on 300 households in Makeni. To ensure proper coverage of the households, the study employs a probabilistic method of sampling (stratified random sampling technique). The CV survey questionnaire generally followed the Mitchell and Carson techniques with modification to adapt the study area. The study also used two elicitation techniques, i.e., checklist and bidding. The primary purpose of incorporating these two elicitation formats into the research design was to test whether respondents' WTP would be influenced by the magnitude of the first price that they received and the sequence of the follow up questions. The two bidding games and the checklist format were randomly assigned to respondents in the study. The study revealed that the elicitation techniques produce different mean WTP implying that respondents' WTP were influenced by the starting point figures.

The data obtained from the CV survey was analyzed in two ways, i.e., descriptive and multivariate analysis. In the multivariate analysis, the research used the Tobit and probit models. A test for starting point bias was also conducted.

One of the most crucial findings from the research is that households were WTP less than the previously charged tariff. Residents of Makeni might have signaled such an amount probably because the water supply project fails to meet their needs and requirements. As a result, SALWACO was unable to recuperate its capital cost and become more reluctant to provide further water supplies, hence the collapse of the system. It is due to the lack of access to a public water system that residents of Makeni used the option of accessing ground water. This option clearly indicates the state's lack of capacity to develop the water infrastructure and to provide its population with water on an equitable basis.

Again, households without water wells in their homes are WTP more than their counterparts with traditional water wells. The WTP frequency table reveals that not every one is WTP for an improved water system, as 9.5 percent of the respondents expressed a zero WTP. The modal WTP figure for a ***havolin*** of improved water is Le 50.00 while the monthly figure is Le 3500.00.

The mean monthly income is Le 101, 000. Thus it is clear that WTP per month is less than 5% of the respondents' income. The World Bank's approach to estimating levels of WTP is by application of the 5% rule. The rule commonly assumes that there is an elastic demand for the purchase of water with a cost of less than 5% of a household's income and an inelastic

demand where the cost exceeds 5% of the household's income. Thus, on the average, respondents were WTP about 3% of their incomes, which is below the 5% level, the implication is that water is treated as elastic good for the respondents and that there is room for households to spend more if they are provided with a better water service.

Based on the WTP figures, the estimated total WTP per month is Le 14 million. What is interesting is that this figure is almost 10 times greater than the reported figure. The optimal tariff from the expected revenue table is Le3000.00. This amount is optimal because it generated the highest expected revenue as compared to the rest of the revealed monthly WTP figures.

The multivariate analysis provides a better insight about the determinants of WTP. Overall, the multivariate results are remarkably robust. The results conclusively show that the WTP information obtained from the survey is systematically related to the socioeconomic characteristics of the household and the respondent in ways suggested by prior expectation. Some of the regression results also compare favourably with empirical findings from other studies.

In the Heckman regression results shown in appendix 8, all the variables that turn out to be significant are also significant in the Tobit model. The marginal effects after the Tobit estimation were reported and interpreted. It was clear from the probit aspect of the analysis that only five variables, i.e., education, responsibility, age, income and water quality have impact on the choice of the respondent of whether to connect to the improved system or not. From the Tobit stage of the analysis, WTP was found to be significant and positively

influenced by the level of education, income of the household head, distance and the quality of water. WTP is also found to be negatively related and significant to the age of the respondent and whom the respond think is responsible for the provision of improved water. The respondents seem to believe that the government should shoulder the responsibility of providing piped borne water and are therefore WTP less. The variables gender of the respondent, number of years in residence, household head and household size were not statistically significant at conventional levels of confidence.

The results obtained from the Tobit selection model are consistent and they also conform to results obtained by previous researchers such as Whittington et al, (1990); Aguilar and Sterner, (1995) and Bah, (1996).

Contingent valuation studies are based on hypothetical markets, as a result we expect the respondents to put up a different behavior when they are confronted with a real market. Hence, the actual behavior of the households of Makeni can be gauged when the improved water system is reintroduced. This suddenly reminds me of an old woman who refused to reveal her WTP during the conduction of the survey based on the adage that "She cannot buy a sheep on the basis of just hearing its voice".

5.2 Policy Recommendations

On the basis of our findings, CV surveys can provide policy relevant information that can be vital to sonorous decision-making.

1. The number of private connections SALWACO inherited from Degremont Water System must be increased; otherwise the Water Authorities will continue to collect revenues that are only a small fraction of its potential.

2. The Water Authorities must embark on an intensive publicity campaign to educate the people about the benefits associated with the need to pay for an improved water service is not only necessary but also sufficient for the sustainability of an improved water system. This recommendation stems from the fact that there is a positive relationship between educational level and WTP.

3. The research cannot recommend an increase in specific charges based on the fact that both the optimal tariff level and the mean monthly WTP are less than the previously existing tariff. Despite this, the revenue to be realized according to the research calculations far outweighs the revenue reported by the Water Authorities. Hence it is clear that even with the previously existing tariff, if there were full cooperation from the consuming public, SALWACO would have been in a position to provide piped water service on an efficient and reliable basis. Besides the aforementioned reason, a good number of the inhabitants of Makeni are poor. Thus, when developing an appropriate tariff structure, the ability to pay of these poor inhabitants must be taken into consideration.

4. The amount respondents are WTP for connection is very minimal as compared to the present cost of materials. The study therefore recommends that SALWACO spread out the cost of connection to be included in the monthly tariff at least for the first year after connection to the improved scheme.

5. The study also recommends an increase in general water charges to reduce free riding. The justification for such a recommendation is that since the previous system was unmetered, homes without water points depend on the good will of their neighbours while they pay nothing at the end of the month. It is believed that revenue to be realized from the increased general water charges can be used for the procurement of materials needed for private connection. Also, an increase in general water charges will encourage more private connections.

6. The new water system, i.e., the gravity system that SALWACO is trying to introduce must be encouraged by the GOSL not only for Makeni but also for the entire country. The reason is that this system requires less materials and equipment. This will curtail the importation of fuel consumed by generators used previously.

In spite of the fact that water is life, it should not be taken for granted that a new system of water supply is always warranted. In some poor environments, local and traditional supplies may be sufficient; therefore attention must be focused on other needs that have higher priority.

However, there is widespread evidence that many people do need improved water service and above all they are WTP for such a service. Since the earlier system in Makeni was poorly managed, we believe that in the future SALWACO must pay attention to the actual needs of the people and the service must be designed to fit their socioeconomic conditions. However, the estimated values should be regarded as approximations because they are not only contingent about the hypothetical market scenario presented to the respondents, but also upon the statistical analysis as well.

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Appendix 1: Survey Questionnaire

Questionnaire[14]

Addis Ababa University

Estimating Households' *Willingness To Pay* for Improved Water Services in Sierra Leone: Evidence From Makeni.

I am currently studying at the Addis Ababa University and this research is a partial fulfillment for the award of M.Sc. Economic Policy Analysis. I am interested to know about the current situation of drinking water in Makeni, the problems you may be experiencing and the reaction to possible improvement in drinking water services. I need your assistance greatly to conduct this study. The answers will be completely confidential and strictly for academic purpose.

Date: ---------- Ward: --------- Street: ----------

Household Characteristics

1. [AGE] Age of Respondent ---------years.

If respondent does not know or does not answer, check the most likely category:

Less than 20 years---------

20 – 29 years ---------

30 – 59 years ----------

Greater than 60 years ------

2. [GEN] Sex of the respondent----- 1=female

0= male

14.This questionnaire format has also been the base for some earlier studies, {Carson, R.T. and Mitchell, R.C. (1993); Aguilar, M and Sterner, T (1995); e.t.c.}.

3 (a). [HOH] Are you the head of the household? ------- 1= Yes

0= No

(b). If no, what is your relation with the head of the household?

4. [HHS] How many individuals live in this house? -------

Total adults (18 years and above) ------Males -----Females---- Total children ---------

5. [EDU] Number of years of education------

6. What is your occupation? ----------

7. [INC] What is your monthly income? ----------

8.What is the total monthly income of the household? ----------

9. [NYR] How many years have you lived in this house? ------

Water Use problems and practice

10. [WQ]. What is the most serious problem with the current water supply?

(a) --------- Quantity

(b) -------- Quality (Good, satisfactory, Poor)

© ---------Reliability

(d) ---------Availability

(e) ----------Others (specify)

11. Have any of your household members suffered from diseases caused by deficient water quality like cholera or diarrhoea in the past one year? --------1= Yes

-------0= No

12. If the answer to Q11 is YES, what is the number of days lost due to disease?

----------Days

13. Which source(s) of water have you used during the last year for domestic purpose?

(a) ------Water wells

(b) -------Piped water

(c) -------Rain water

(d)-------Others (specify)

14. If the answer to 12 is (b), do you normally pay for this service?

--------1=Yes

--------0 =No

15. [DIS]. What is the distance of your current source of water from home?

---- Metres

----- I have water well within the compound

16. [RES]. Who do you think should be responsible for water supply and management?

Willingness To pay

17. [INF]. Do you have any idea about the water rehabilitation programme that is presently in progress in Makeni? -------- 1 = Yes

-------- 0 = No

18. [NSi]. Assume you will be offered a better water service, which implies good quality and constant water supply throughout the year which requires payment, Would you be interested in the system? -------- 1 = Yes

-------- 0 = No

19. If the answer to 18 is NO, what is the main reason?

(a)--------- Satisfied with the current service

(b)-------- I do not have enough money to pay for the new system

(c) -------- Others (specify)

(d)---------99 = Not applicable

For the attention of the enumerators: Question 20 is only applicable to Sample 1; the checklist format.

20. If the answer to 18 is YES, can you tell me how much is the maximum amount you will be willing to pay for this new service per ***havolin*** (five gallon container) in leones?

---------- 0,10,20,50,100, 300, 400, 500,

----------99 = Not applicable

For the attention of the enumerators: Questions 21 –26 are only applicable to Sample2; the bidding game format.

Low starting value

21. Are you wiling to pay Le10 per **havolin** of safe drinking water? ----------YES

----------NO

If NO, go to 23, if YES go to 22.

22. Are you willing to pay Le50 per **havolin** of safe drinking water? ----------YES

----------NO

If YES then go to23.

23. What is the maximum amount are you willing to pay for the service described? -------

High starting value

24. Are you willing to pay Le1000 per **havolin** of safe drinking water? ----------YES

----------NO

If NO go to 25 and if YES, go to 26.

25. Are you willing to pay Le500? ----------YES

----------NO

If NO then go to 26.

26.What is the maximum amount are you willing to pay for the service described? --------

27.If the flat rate for each household is to be set, for this service, to enhance sustainability, what is the maximum amount that you can pay per month in Leones?

--------- 99 = Not applicable

28. What kind of payment system would you desire?

(a) Monthly flat rate

(b) Annual flat rate

(c) Cash per ***havolin*** to be paid monthly

(d) Cash per ***havolin*** to be paid annually

29. Would you be prepared to pay for a standpipe? ------- 1 = Yes

---------0 = No

30. If the answer to 29 is YES, what is the maximum amount that you are prepared to pay for connection? ----------

Respondent suggestions

31. Do you have any suggestion that will ensure safe drinking water for all?

For Enumerators Only

32. Was the respondent irritated or nervous during the interview? -----YES

------NO

33. Do you think the respondent made an effort to tell the truth?

(a) About the Willingness To Pay? -------YES

-------NO

(b) About the income? -------YES

-------NO

34. How would you rate the overall quality of the interview?

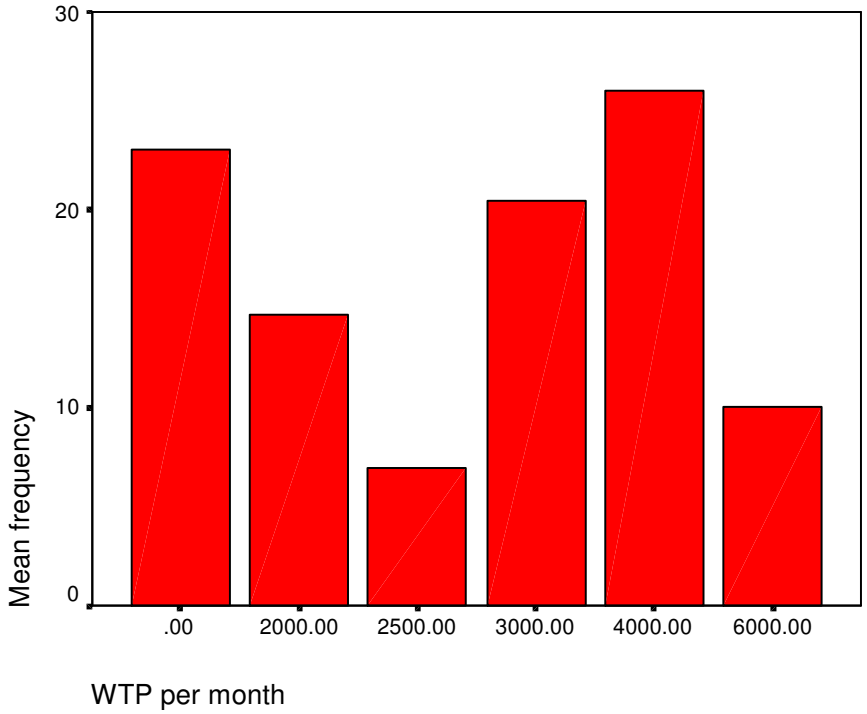
-------Good ------Fair --------Poor -------

Appendix 2: Socioeconomic profile of the sample

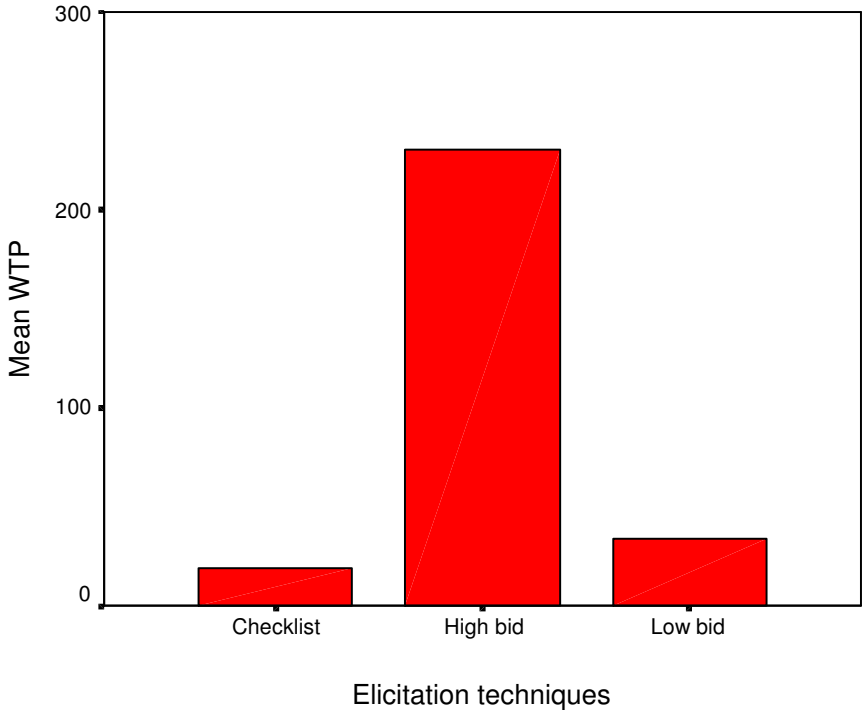
	N	Minimum	Maximum	Mean	Std. Deviation
Age of respondent	283	19	90	45.6	14.6
Sex of respondent, 1 for female and zero for male	283	0	1	0.3	0.5
Head of household, 1 for household head and zero for any other ember	283	0	1	0.9	0.4
Household size	283	1	24	14.4	7.2
Educational level of the respondent	283	0	29	7.0	6.5
Number of years in residence	283	1	60	16.6	12.8
Quality of water	283	0	1	0.4	0.5
Distance from current source of Water (in meters)	283	0	1000	76.5	165.7
WTP per ***havolin***	283	0	1000	87.4	143.80
WTP per month	273	0	20000	3016.50	2755.10
WTP for connection	267	0	50000	6073.00	6313.70
Monthly income of household head	283	0	400000	101222.60	66377.80

Source: Survey Data

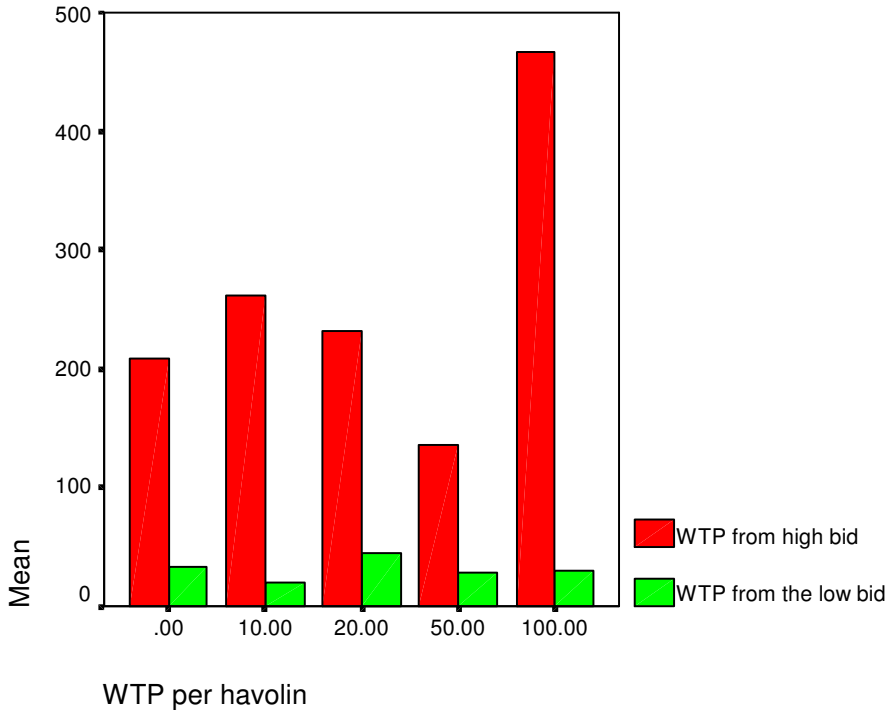
Appendix 3: WTP frequency distribution (Leones / month)



Appendix 4: Bar graph showing the mean WTP of the various elicitation techniques



Appendix 5**:** Bar graph indicating the effect of starting point on WTP bids



Appendix 6: Two-tailed t-test calculations

From equations 9 and 10,

X_1 = the mean WTP from high bid

X_2= the mean WTP from low bid

N_1= number of observations of high bids

N_2= number of observations of low bids

S_1= standard deviation of high bids

S_2= standard deviation of low bids

The t-critical is at $N_1 + N_2 - 2$ df

$X_1 = 230.89$ $S_1 = 214.99$ $N_1 = 67$

$X_2 = 33.33$ $S_2 = 62.98$ $N_2 = 69$

From equation 4.2,

$S_p^2 = \{(67-1)214.99^2 + (69-1)62.98^2\}/(67+69-2)$

$= (66*46220.7 + 68*3966.48)/134$

$=(3050566.2+269720.64)/134$

$=3320286.84/134$

$=24778.26$

$S_p = \sqrt{24778.26}$

$=157.4$

From equation 4.1,

$T =(230.89-33.33)/157.4\sqrt{(1/67 +1/69)}$

$=197.56/157.4\sqrt{(0.0149+0.0145)}$

$=197.56/157.4\sqrt{0.0194}$

$=197.56/21.9233$

$=9.01$

The t- critical is at 67+69 –2 df =134df.

Appendix 7: Correlation Matrix of the Explanatory Variables

	AGE	SEX	HOH	HHS	EDU	INC	NYR	WQ	DIS	RES	AGE
	1.0000										
SEX	0.0604	1.0000									
HOH	0.1860	-0.1317	1.0000								
HHS	0.0960	-0.0379	0.0230	1.0000							
EDU	-0.2875	-0.2835	-0.1269	-0.0634	1.0000						
INC	-0.0011	-0.0310	0.1007	0.0089	0.0559	1.0000					
NYR	0.1577	0.0463	0.1082	0.1445	-0.1224	-0.0714					
WQ	-0.0117	0.0650	-0.0262	-0.0039	-0.0637	-0.0741	-1.0000				
DIS	-0.0254	-0.0424	0.0072	0.0175	0.0253	0.0709	-0.0976	1.0000			
RES	-0.0217	0.0544	0.0223	0.0460	0.0260	-0.0144	-0.0324	0.0882	1.0000		

Appendix 8: Heckman Selection Model

Dependent Variable, ACi		
Variable	Coefficient	z- statistic
Education	0.045	2.39**
Water Quality	0.338	2.14*
Responsibility	-0.975	-2.32**
Constant	0.439	2.34*
Dependent Variable, WTPi		
Age	0.259	5.12***
Age Squared	-0.003	-3.93***
Education	0.072	3.43***
Income	0.617	6.12***
Water Quality	0.258	2.41*
Responsibility	-1.117	-4.79***
Number of years in Residence	-0.012	-3.46***
Elicitation Dummy	0.571	2.21*
Constant	6.337	4.96***
Lambda	0.457	2.05**
athrho	0.433	2.20**
$R^2 = 0.28$ LR= 24.06 Log likelihood=59.71 N = 282 Censored observations = 26 Uncensored observations = 256		

*** Significant at 1percent level **Significant at 5 percent level *Significant at 10 percent level

Appendix 9: Marginal Effects after Heckman

Variable	Marginal effect	z-statistic
Age	0.221	5.49
Age squared	-0.002	-3.29
Education	0.039	2.89
Water Quality	0.103	2.17
RES	-0.266	-2.54
Income	0.549	2.01
Number of years in Residence	-0.004	-2.11